ARMY ORDNANCE

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

Founded 1920

For Victory through Armament Research, Production, and Supply

Volume XXV SEPTEMBER-OCTOBER, 1943 No. 140

CONTENTS

Ready for Anything	Frontispiece	
Wings, Bombs, and Bullets	Gen. H. H. Arnold	317
"Keep 'Em Shooting!"	Maj. Gen. Levin H. Campbell, Jr.	321
Our Weapons in North Africa	Maj. Gen. G. M. Barnes	327
British Armament	Maj. Gen. H. Rowan-Robinson	331
The Army's New 2½-ton Amphibious Truck	(Pictorial)	336
Recent Developments in Army Matériel	(Pictorial)	337
Ordnance with the Air Forces	Col. Harold J. Conway	338
Aërial Firepower	(Pictorial)	341
The New Submachine Gun, M3	Col. René R. Studler	349
Desert Salvage	Lieut. Col. G. Burling Jarrett	353
Month by Month		355
Membership in the Army Ordnance Association	*Facing*	356
Association Affairs		357
The Ordnance Endowment Honor Roll		359
Ordnance in Review	Lieut. Col. Calvin Goddard	364
Professional Digest		368
Preventive Maintenance	Col. T. L. Preble	373
Book Reviews		376
Index of Advertisements		460

(Publication date: August 26, 1943)

Published by the Army Ordnance Association, Suite 705, Mills Building, Washington 6, D.C. Editor: Brig. Gen. R. H. Somers, U. S. Army, Ret.; Associate Editor: R. E. Lewis, Jr. Authors are responsible for statements and opinions expressed in their articles. Copyright, 1943, by the Army Ordnance Association, Washington, D. C. Permission for republication in whole or in part must be obtained in advance.

Issued bimonthly. Single copy 75c (by mail). Subscription rate: continental U. S. and possessions, $4.50 annually, in advance. Entered as second-class matter, August 14, 1920, at the Post Office at Washington, D. C., under the Act of March 3, 1879. Additional second-class entry at the Post Office at Richmond, Va. Three weeks' notice before publication date of next issue required for change of address.

THE ARMY ORDNANCE ASSOCIATION

The Aims, Purposes, and National Officers of the Society

THE Army Ordnance Association, a national society of over 15,000 American citizens, was founded in 1919, "pledged to industrial preparedness for war as our nation's strongest guaranty of peace." The society was incorporated under the laws of the District of Columbia in 1928. Its entire energies are now dedicated to victory for the armed forces of the United States. For the duration of the war it is "pledged to victory—complete, absolute, final."

The Association has endeavored during the past twenty-four years to keep alive an interest in and knowledge of the design, production, and maintenance of military armament. This it has done through periods of public lassitude and times of great national emergency. Until 1940 there was no peace-time armament industry in the United States for the production of ordnance. Now all American industry is geared for victorious war production.

The principal objective of the society is an active membership of American citizens to assist in the design, development, procurement, production, maintenance, and supply functions of the Ordnance Department of the United States Army. When peace returns, this body of informed citizens will again continue to be a bulwark of knowledge, experience, and ability upon whom the Armed Forces of the United States can rely for technical and scientific assistance and for industrial preparedness.

The Association is devoted solely to the national defense; it has no commercial interests, no political alliances, and no religious affiliations. It is not operated for profit: its income is expended in furthering its aims. Its elected officers and directors serve without remuneration. Membership, to which American male citizens are eligible, is four dollars a year. (Application facing p. 356.) There are twenty-two local chapters of the Association throughout the United States.

ARMY ORDNANCE, the journal of the Association, is published solely for the purpose of disseminating information on the progress of our munitions developments so that American industry may at all times know its responsibilities to the common defense.

The objectives of the Association as set forth in its Constitution are:

To assist in effecting industrial preparedness for war as being one of the nation's strongest guaranties of peace;

To keep available the highly specialized knowledge necessary for arming the manhood of the nation by stimulating interest in the design and production of ordnance material;

To promote mutual understanding and to effect coöperation with American scientists, inventors, engineers and manufacturers in civil life and the Regular and Reserve officers of the Ordnance Department;

To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects;

To assist in developing and maintaining an efficient personnel, both commissioned and enlisted, for the units required for Ordnance Field Service in the event of an emergency;

To commemorate the services rendered by the industry of the nation and by the officers and civilian employees of the Ordnance Department in the wars in which the United States has been engaged.

Officers

President: BRIG. GEN. BENEDICT CROWELL, Cleveland, Ohio
Vice-President: COL. WILLIAM W. COLEMAN, Milwaukee, Wis.
Vice-President: COL. FREDERICK H. PAYNE, Greenfield, Mass.
Vice-President: COL. JAMES L. WALSH, New York, N. Y.
Treasurer: BRIG. GEN. CHAS. ELLIOT WARREN, New York, N. Y.
Counsel: BRIG. GEN. JOHN ROSS DELAFIELD, New York, N. Y.

Directors

COL. HERBERT W. ALDEN, Detroit, Mich.
MR. JOHN D. BIGGERS, Toledo, Ohio
COL. BRUCE CORNWALL, San Francisco, Calif.
MR. W. C. DICKERMAN, New York, N. Y.
MR. GEORGE W. ELLIOTT, Philadelphia, Pa.
COL. HERBERT A. GIDNEY, Pittsburgh, Pa.
MR. EARL B. GILMORE, Los Angeles, Calif.
MR. T. M. GIRDLER, Cleveland, Ohio
COL. ARTHUR W. HERRINGTON, Washington, D. C.
COL. ROBERT P. LAMONT, New York, N. Y.
BRIG. GEN. SAMUEL MCROBERTS, New York, N. Y.
MR. THOMAS A. MORGAN, New York, N. Y.
MR. EDMUND A. RUSSELL, Chicago, Ill.
COL. FRANK A. SCOTT, Cleveland, Ohio
COL. HARRY SCULLIN, St. Louis, Mo.
COL. THEODORE SWANN, Birmingham, Ala.
COL. CHARLES H. TENNEY, Springfield, Mass.
MR. AUGUST H. TUECHTER, Cincinnati, Ohio
HON. JAMES W. WADSWORTH, Geneseo, N. Y.
COL. JAMES L. WALSH, New York, N. Y.

Executive Secretary: BRIG. GEN. R. H. SOMERS, U. S. Army, Ret.
Assistant Secretary: FLORENCE G. FERRITER
Executive Offices: Mills Building, Pennsylvania Avenue at 17th Street, Washington 6, D. C.

LOCAL POSTS OF THE ASSOCIATION

The Officers, Charter Dates, and Headquarters of the Twenty-Two Chapters

Birmingham, December 3, 1930.—President: Theodore Swann. Vice-President: Lindley C. Morton. Directors: Thomas Martin, Oscar Wells, Hugh Morrow, W. D. Moore, Erskine Ramsay, L. E. Geohegan, Wade H. Oldham, R. C. Stobert. Treasurer: Richard J. Stockham. Secretary: E. C. Bomar, 700 Frank Nelson Building, Birmingham, Ala.

Boston, June 30, 1925.—President: Carl P. Dennett. Vice-President: H. P. Richardson. Directors: T. L. Ames, R. J. Thanisch, M. T. Carney, A. E. Anderson, C. E. Fuller, W. Van Pattensteiger, R. E. Goho. Secretary-Treasurer: J. E. Ratigan, 140 Federal Street, Boston, Mass.

Chicago, May 3, 1924.—President: Edmund A. Russell. Vice-President: F. W. Parker, Jr. Directors: W. E. Crocombe, W. H. Damon, T. S. Hammond, Sterling Morton, Fred A. Preston, W. R. Wright. Treasurer: G. V. Rountree. Assistant Secretary: F. W. Renwick, Jr. Secretary: J. W. Cavanaugh, 38 S. Dearborn Street, Chicago, Ill.

Cincinnati, December 10, 1925.—President: Harvey C. Knowles. Vice-President: Richard E. LeBlond. Directors: Frederick V. Geier, A. W. Herrington, A. F. Hubbard, C. H. Kindl, H. C. Knowles, E. A. Muller, A. H. Pugh, S. E. Steinbeck. Treasurer: E. W. Harrison. Secretary: Fred A. McMahon, Big Four Building, Cincinnati, Ohio.

Cleveland, October 25, 1940.—President: Clifford F. Hood. Vice-Presidents: John C. McHannan, Rufus J. Wysor. Directors: Robert F. Black, Hosea T. Bradner, Ward M. Canaday, Fred Chapin, Frederick C. Crawford, Ben F. Hopkins, Adrian D. Joyce, Frank Purnell, Edward J. Thomas. Secretary-Treasurer: Harold M. Reedall, 1006 Terminal Tower, Cleveland, Ohio.

Detroit, December 12, 1942.—President: H. W. Alden. 1st Vice-President: Edward T. Gushée. 2nd Vice-President: George D. Bailey. Directors: Charles T. Bush, C. H. Hodges, Jr., George M. Holley, Phil Huber, O. E. Hunt, K. T. Keller, William C. Lerchen, C. J. Reese, S. T. Stackpole. Secretary-Treasurer: John W. Paynter, 1289 National Bank Building, Detroit, Mich.

Hartford-Springfield, November 18, 1941.—President: Frederick H. Payne. Vice-President: C. H. Granger. Directors: H. C. Beaver, E. P. Bullard, E. B. Gallaher, S. C. Hope, Earl McFarland. Secretary-Treasurer: G. H. Drewry, 95 State Street, Springfield, Mass.

Lehigh-Bethlehem, November 15, 1939.—President: Howard V. Donohoe. 1st Vice-President: R. B. Gerhardt. 2nd Vice-President: John D. Van Blarcom. Treasurer: Theodore G. Scott, Jr. Secretary: Robert G. Taylor, 406 Delaware Avenue, Bethlehem, Pa.

Los Angeles, May 27, 1936.—President: Earl B. Gilmore. Vice-President: Donald Douglas. Directors: W. H. Adams, A. R. Baird, Ralph O. Cragin, H. S. Hitchcock, M. A. Koffman, M. M. Mitchell, F. B. Cole, K. T. Norris. Treasurer: Samuel K. Rindge. Secretary: R. C. Scott, 2423 E. 28th Street, Los Angeles, Calif.

Massachusetts Institute of Technology, January 20, 1922.—President: Frederick Cavanaugh. Vice-President: James Buchanan. Secretary-Treasurer: Robert Fisher, 45 Warren Street, Newton Centre, Mass.

Milwaukee, September 26, 1928.—President: W. W. Coleman. Vice-President: J. E. DeLong. Directors: Pierpont J. E. Wood, Roger Sherman Hoar, H. Stanley Johnson, Jr., D. P. Davies, H. V. Kohler, Frank R. Bacon, Harold Falk, Robert A. Uihlein. Secretary-Treasurer: F. O. Wyse, Bucyrus-Erie Company, So. Milwaukee, Wis.

New York, June 15, 1921.—President: R. E. Gillmor. 1st Vice-President: Crosby Field. 2nd Vice-President: James E. McNary. 3rd Vice-President: Thomas E. Murray. 4th Vice-President: H. M. Tillinghast. Executive Committee: The officers and Thomas F. Brown, A. E. Van Cleve, W. C. Dickerman, Charles J. Hardy, Carl W. Keuffel, Frank Johnson. Treasurer: James E. McNary. Secretary: Chester Mueller, 80 Broadway, New York, N. Y.

New York University, April 16, 1943.—President: T. R. Torian. Vice-President: M. L. Goldstone. Directors: H. W. Sternfeld, Elliot Schick, H. S. Davis, R. F. Borg, I. Eisen. Secretary-Treasurer: H. S. Davis, Department of Administrative Engineering, New York University, New York, N. Y.

Philadelphia, December 9, 1926.—President: C. Jared Ingersoll. Vice-Presidents: William D. Disston, George W. Elliott. Directors: E. G. Budd, D. K. Bullens, R. A. Cannon, W. D. Disston, G. W. Elliott, L. E. Hess, S. F. Laucks, E. J. Longstreth, Walter F. Perkins, W. Wear. Secretary-Treasurer: D. N. Hauseman, 1300 Mitten Building, Philadelphia, Pa.

Pittsburgh, February 24, 1927.—President: H. A. Gidney. Vice-Presidents: J. D. Berg, R. C. Downie. Directors: F. B. Bell, W. F. Detwiler, J. K. B. Hare, J. L. Perry, G. M. Sixsmith, A. E. Walker. Secretary-Treasurer: T. H. Eddy, 800-D Chamber of Commerce Building, Pittsburgh, Pa.

Rochester, April 29, 1938.—President: Frank J. Smith. Vice-President: Edward A. Halbleib. Directors: J. K. Baylis, James E. Gleason, Carl S. Hallauer, F. F. Hickey, William Kelly, Thomas L. Lee, David W. Sowers, Albert F. Sulzer. Treasurer: E. R. Davenport. Secretary: F. J. Atwood, 1238 Mercantile Building, Rochester 4, N. Y.

Rocky Mountain Post, June 10, 1942.—President: Newell H. Orr. Vice-President: John G. Gates. Directors: A. T. Twing, C. O. Voigt, L. F. Quigg, James D. Maitland, Harold F. Silver. Secretary-Treasurer: James Colasanti, 601 Continental Oil Building, Denver, Colo.

St. Louis, January 18, 1927.—President: Edwin B. Meissner. Vice-President: Robert A. Bagnell. Directors: Harry Scullin, Spencer Olin, P. J. Watson, Jr., Willard R. Cox, Ben Comfort, H. B. Deal, W. M. Akin, W. Stuart Symington. Secretary: Merle H. Davis, 3663 Lindell Boulevard, St. Louis, Mo.

San Francisco, October 17, 1923.—President: Roland L. Oliver. Vice-President: Leonard F. Fuller. Directors: D. C. Jackling, J. J. Thomas, Samuel Kahn, A. Leslie Oliver. Secretary-Treasurer: C. C. Harshman, 402 Hotel Empire, San Francisco, Calif.

Texas, October 30, 1942.—President: B. T. McNeil. Vice-President: W. R. England. Directors: J. E. Rittersbacker, J. E. Mitchell, Jr., W. C. Trout, H. Sinclair, J. M. Kincaid, Jr., Colin McRae. Secretary-Treasurer: R. D. Campbell, 927 Liberty Bank Building, Dallas, Tex.

University of Michigan, February 20, 1941.—President: George Brundrett. Vice-President: Leslie Parr. Recording Secretary-Treasurer: James Carmichael. Corresponding Secretary: Arthur S. Wiseman, Jr., 322 Winchell House, Ann Arbor, Mich.

Washington, November 18, 1925.—President: G. M. Barnes. Vice-Presidents: Henry P. Erwin, B. S. Mesick. Directors: Fred E. Wright, LeRoy Hodges, Fred. H. Wagner, Hardee Chambliss, S. E. Reimel, Philip Schwartz. Treasurer: Ralph I. Graves. Secretary: R. G. Van Ness, 705 Mills Building, Washington 6, D. C.

This is one of a series of posters designed and published by the Ordnance Department, U. S. Army, as a stimulus to war production in armament plants throughout the country.

ARMY ORDNANCE

Volume XXV SEPTEMBER-OCTOBER, 1943 No. 140

Wings, Bombs, and Bullets

The Striking Power of the Ordnance-Air Forces Team

Gen. H. H. Arnold

WHEN the white flags of surrender began to appear on the airfield and on the hilltops of Pantelleria that morning of June 11th, it was a dramatic demonstration of what modern air power can do. Because of our relentless aërial bombardment, heavily fortified Pantelleria was forced to surrender according to terms set forth in leaflets dropped from planes earlier in the week. It was victory—by air. Nearly 2,000 tons of bombs alone were dropped upon the island in the final twenty four hours, destroying its guns, its buildings, its planes, equipment, and supplies. We made Pantelleria's ground fortress an intolerable hell for the 11,000 men in it, and they gave up—gladly.

If the garrison had not surrendered early, much higher records of air activity would have been set. Our schedule called for increasing numbers of planes and an increasing intensity of destruction.

This same air force, increasing in numbers daily, is now carrying a greater offensive to Europe itself, bringing the war home to Berlin, Rome, and other Axis cities with a new kind of power and fear. Behind this force's creation and successes is a story of hard work by people with ideas about planes, bombs, guns, and armor that have made them the best in the world today.

WE are happy to present in these pages this tribute from General Arnold to the efficiency and effectiveness of our Ordnance service with the Air Forces. The success of aërial combat, as of all warfare, depends on teamwork: Airplanes would be ineffective without guns, ammunition, and high explosives; bombs would remain impotent unless flown to and dropped accurately upon their objectives. But above all, without the close coöperation of loyal, courageous men in the air and on the ground, our finest matériel and ammunition would be ineffective. That the United States possesses a smooth-working Ordnance-Air Forces team is emphasized not only by General Arnold's words here but by the triumphal record of our air power in every theater of global war.—EDITOR.

What a comparison today's air operations make with those of World War I! In four days from September 12 to September 16, 1918, American aviators made 3,300 flights over the line in the St.-Mihiel offensive, fired 30,000 rounds of caliber .30 machine-gun ammunition, made 1,000 individual bomb attacks, and dropped 75 tons of bombs. This was a performance record that drew the very high praise of General Pershing.

The arming of American aircraft dates back to the early days at College Park, Md., when about a dozen of us were learning to fly at the Army's first air school. We used one of the earliest Wright airplanes. A Lewis gun was carried in the lap of a passenger. Initial experiments were conducted in dropping inert objects on ground targets, and this practice developed naturally into bombardment procedures that were placed in effect in World War I.

When that war started in 1914, the airplane was regarded chiefly as an observation platform, hung in the sky. From the very moment, however, that enemy airmen stopped waving at each other and began firing at each other, military developments came thick and fast. When the U. S. entered the war in April 1917, Army aviation, then the aviation section of the Signal Corps, consisted of some 65 officers and 1,087 enlisted men. We had only fifty-five airplanes, and none of them had all the improvements that that were being made from month to month on the Western Front. But we went to civilian ranks for our fliers —and got them—and our factories pitched in to build planes, although a scant half dozen had had previous experience. American aviation responded quickly and effectively to meet the challenge when we entered the war.

At McCook Field, Dayton, Ohio, our aircraft and Ordnance designers and engineers installed new gun mounts on various types of fighter planes. They put a 37-mm. cannon with a clip cartridge belt in the nose of a twin-engined Martin bomber and developed and mounted new types of Lewis and Browning fixed and flexible guns, for the guns that had been used were chiefly adapted ground guns. An automatic bomb sight was developed which might have further emphasized the importance of bombing in the last war had it reached the front. Leakproof gas tanks and armor plating were also introduced, but the war was over before much could be done about their practical application.

THREE main types of bombs were developed and used during the last war. Demolition bombs were of light case steel filled with TNT and made in weights of 50, 100, 250, 500, 1,000, and 1,600 pounds. Compared with our present bombs they were deficient in the case strength needed for good penetration. Fragmentation bombs weighed about twenty pounds and consisted chiefly of rejected artillery shells that had been modified. Incendiary bombs weighed about fifty pounds and were loaded with oil emulsion, thermite, or metallic sodium which burned with intense heat for a few minutes upon the explosion of the bombs. There were

General Arnold is Commanding General of the U. S. Army Air Forces.

Air Forces

THE MARTIN B-26 MARAUDER MEDIUM BOMBER

also 6-ounce miniature thermite incendiary bombs packed in a bomb-shaped container of 100-pound size. This container opened upon release, scattering the miniature bombs.

Up until the early 1920's the Ordnance Department had been responsible for the design, development, and procurement of all armament equipment; that is, guns, gun mounts, gun controls, ammunition, bombs, bomb racks, bomb sights, flares, and pyrotechnic signals. The Department did an excellent job of keeping abreast of the rapid development of airplanes. However, as the airplane began to require more detailed design and to require the gun mounts and bomb racks to be parts of the basic design and airplane structure, it was advantageous to assign the responsibility of all aircraft armament, with the exception of the basic guns, ammunition, bombs, and pyrotechnics, to the Air Corps.

An intense development was begun by Ordnance on weapons solely for airplanes. So, following the peacetime policy of developing quality with the limited funds available and depending on the American mass-production genius to produce this quality in quantity in time of emergency, great progress was made. In 1939 we had an aircraft caliber .30 machine gun that was dependable, adaptable to all types of installations, and could fire 1,200 rounds a minute. But armor plate and leakproof gas tanks made it inadequate.

With foresight, the Ordnance Department had the caliber .50 aircraft machine gun ready for use. This gun weighs only 64 pounds and can discharge up to 800 projectiles a minute at a velocity of 2,800 feet a second. Our present airplanes are literally bristling with these guns. In fighters you will find four, six, and more fixed in the wings or fuselage. It is no small wonder that enemy aircraft, motor vehicles, and ground installations suffer so heavily. Our long-range bombers have been able to accomplish their missions to objectives too distant for our fighters to escort them. The very low mortality rate of these bombers can largely be credited to this splendid gun.

In all combat theaters our aircraft use cannon varying in size from the 20-mm. to the 37-mm. About 1935, a 20-mm. cannon was installed on an attack ship. Two years later the unique twin-engined pusher plane, Airacuda, was flown with two 37-mm. cannon projecting from its engine nacelles. Then came the Bell P-39 Airacobra with the 37-mm. cannon firing through the propeller hub (see illustrations on p. 347). This first cannon was a modification of the World War I 37-mm. ground gun, but specially designed light, fast-firing, high-velocity guns are being installed in our planes now coming off the production lines. The new 37-mm. penetrates tank armor. The 37-mm. cannon is by no means the end of the trail. Much additional work has been done on heavy equipment, and planes with surprising developments in heavy aircraft cannon will soon appear on the combat fronts.

THE outstanding small-arms development for use against airplanes was the incendiary caliber .50 cartridge. The most vulnerable part of a modern airplane is the gas tank. With the advent of the self-sealing gas tank, it was found that tracer ammunition was ineffective for setting aircraft on fire. So caliber .50 incendiary projectiles were introduced. These, fired in conjunction with armor-piercing bullets, make the caliber .50 the best gun for airplanes to date.

In the last war, the ordinary ring-and-bead sight was used almost entirely. Today, this sight is used only on hand-held guns, for our planes mount a reflector sight which projects a parallel-ray beam of light, causing a ring on a bead to appear as if it were on the target. This ring and bead can be seen from many points in the cockpit, enabling the pilot to control his airplane in order to place the target in the proper position. The gun camera aids greatly in making our pilots expert marksmen. Shooting pictures in place of bullets in simulated dogfights, it produces an undeniable record. These cameras are often used in combat in conjunction with real bullets to check marksmanship and results.

Very shortly after the first World War, it was realized that our bombs could be greatly improved. In 1921, a joint bomb board composed of members from the many interested branches and services was convened by the War Department. The findings of this board constituted a guide for the Ordnance Department and for the Air Corps in the perfection of the bombs, fuzes, and bombing equipment in the various series up to and including the present.

There are three categories of aërial bombs: demolition, fragmentation, and chemical. The demolition bomb was designed to blast a wall apart, to burst a hole in a ship, to excavate the foundation of a structure, or to crumple a dam.

A demolition bomb is a packing case carrying a charge of high explosive to the point where it can be used to the greatest advantage. It is housed in a bomb body or case which is made as light as possible yet with sufficient structural strength to give the penetration necessary and to avoid breaking open on striking its objective.

The chief factor in obtaining the maximum destruction from an explosive is confinement. The destruction wrought by a well-confined explosive may be four to five times as great as the same amount unconfined. The bomb is made to penetrate a building, the ground, a ship, or the water beside a ship. This requires demolition bombs of varying hardness and case thickness in order to carry the maximum amount of explosive to the center of the target. The several types are: general-purpose, semi-armor-piercing, armor-piercing, light-case, and depth bombs.

UP until the late 1920's, demolition-bomb construction was based on a design of cast sections welded to plate steel. At this time it was realized that targets for bombs were increasing in toughness and resistance. The forged bomb case was introduced which had a tensile strength of 90,000 pounds per square inch. This required heavy forging machinery which would not be available for war production. To meet this difficulty, a combined forged and welded bomb was fabricated. The investigation led to our present general-purpose bomb which has a minimum case strength of 105,000 pounds per square inch whether forged or welded. The general-purpose bomb is made of such strength that it can be dropped without rupturing against a concrete slab 4 feet thick from an altitude of 8,000 feet. Using a delay-action fuze, bombs of this type can crash through to the basement of most buildings, bury themselves several feet in the ground near a bridge, or penetrate the deck of all seacraft except the thickly armored decks of heavy cruisers and battleships.

The general-purpose bomb is made in five sizes, which will produce damage as follows:

100-pound.—Demolish an average 2-story building, wreck a locomotive, gun installation, or other machinery from 10 feet, and damage an airplane by fragments from 75 feet.

250-pound.—Destroy the walls and floors of all types of buildings except skyscrapers, sink or severely damage all seacraft except battleships and cruisers as far as 20 feet away, cut railway tracks and tear them up for 30 feet.

500-pound.—Cause 75 feet of concrete dock to collapse from 25 feet away, cause collapse of steel railway bridges and subway passages, sink or seriously damage light cruisers as far as 25 feet away, penetrate and completely demolish most tanks. This is the bomb that sank about 39 Japanese transports and cargo ships in the Macassar Straits.

1000-pound.—Displace piers and spans of heaviest bridges.

2000-pound.—Crack or burst a large hole in dams, sink or seriously damage battle cruisers and battleships of the most modern construction on direct hits or as far as 35 feet away when exploded in the water.

The general-purpose bomb can be used effectively against nearly every objective by using the proper tactics. It can be used by the Army Air Forces, the U. S. Navy, and the Royal Air Force. It can even split the sides of a submarine on detonating at the proper depth. This is accomplished by using a fuze with the proper delay action or by incorporating the Navy hydrostatic tail fuze.

To reach the vital organs of targets which the general-purpose bomb will not penetrate, 500-pound and 1,000-pound semi-armor-piercing bombs were developed. The heaviest tank can be punctured by the 500-pound semi-armor-piercing bomb while the 1,000-pound bomb of this type will pierce the sides or decks of all seacraft, except battle cruisers and battleships.

Seacoast-mortar shells have been converted and adapted with fins to become armor-piercing bombs. These bombs are generally capable of penetrating the armor of battle cruisers and battleships. This type is not often used, since the explosive content is so small that a near miss will have negligible effect, while a 2,000-pound general-purpose bomb will do considerable damage as far as 55 feet from a battleship. Armor-piercing bombs weigh 600, 800, 900, 1,000, 1,400, and 1,600 pounds.

The light-case bomb was designed for a target that can best be attacked by air blast, such as a congested city block.

Our planes patrolling the seas from convoys, from the shores of combat theaters, and from our own shores continually surprise enemy submarines. To blast them out of existence, an adequate amount of explosive must be delivered to the proper depth. This is accomplished by one of two depth bombs, the 325-pound or the 650-pound. These bombs are of very light case and are functioned by a Navy hydrostatic fuze.

To insure functioning, our general-purpose bombs have both a nose and tail fuze. They are made with different delays in functioning to meet the requirements of the targets. To insure the safety of the plane dropping the bombs, the fuzes are of such construction as to make it almost impossible for the bomb to detonate accidentally.

THE real power of fragmentation is being realized every day in the present conflict. The fragmentation bomb made its appearance during the last war as a 20-pound, cast-steel or forged shell. Its high-explosive core would break the forged shell into about 250 to 300 pieces and the cast steel shell into fewer pieces plus a considerable amount of ineffective powder. The double requirement that exists for demolition bombs—that they should produce their effect primarily by blast and secondarily by fragments—is reduced to a single purpose with fragmentation bombs—they produce destruction as a result of fragmentation of the bomb case. Our fragmentation bombs of today consist of steel cylinders with end caps and contain an explosive core of TNT. A spiral coil made from rectangular iron rod covers the outside of the cylinders. They break into 1,000 to 1,500 pieces of about 0.3-ounce average weight, having velocities up to 4,000 feet a second. At 200 feet, the fragments will go through an airplane wing or gas tank, tires and control wires, or perforate radiators and intercoolers.

In order to give low-flying bombers time to escape and also to allow the fragmentation bomb to strike squarely on its nose, the condition which produces the maximum effect, it was necessary to attach a parachute to the bomb. Perhaps the greatest demonstration of parachute bombing ever seen was in the Battle of New Guinea. As the Japanese were crossing the Owen Stanley Range attempting to take Port Moresby, every type of combat possible was waged against

them, but the one thing they could not contend with was the fragmentation bomb. Dropped against front-line infantry and against the lines of communications, the bombs kept the troops and pack trains off the trails, forcing them to be without food and water. There are many examples of airdromes, supply trains, and encampments cut to pieces by these bombs.

A third type of bomb, some of which are in use and others held in readiness by the A.A.F., is the chemical bomb. The chemical agents, which are procured by the Chemical Warfare Service, may be any of the following types: (1) Harassing agents which hinder the operation of troops by forcing them to wear their gas masks, or to remove them in order to sneeze or vomit, thus rendering them vulnerable to other gases; (2) Casualty agents which do bodily harm, such as chlorine, mustard gas, or phosgene; (3) Screening smokes—agents producing dense, obscuring smoke; (4) Incendiary agents which produce much heat and set fire to combustible material.

The chemical bomb has a very light steel case that may be filled with also most any chemical agent and weighs 100 pounds. Filled with mustard gas, it becomes a casualty bomb; filled with white phosphorus, it becomes an incendiary and smoke bomb. A plane may carry from 1,500 to 2,000 small incendiary bombs. These weigh about 4 pounds and burn at temperatures of 3,300 degrees to 4,500 degrees Fahrenheit. Packed in clusters, they open as they fall.

THE perfection of our armament in combat can only be obtained by the full coöperation between the Ordnance designers in their work on weapons and ammunition and the Air Forces designers in their work on airplanes to carry these weapons and ammunition. The Air Forces has maintained a testing unit at Aberdeen Proving Ground for a number of years. This unit supplements the regular Ordnance installations in the development and test of all types of armament equipment. The ballistics research laboratory at Aberdeen Proving Ground, through the use of this unit, is able to furnish necessary technical information and data to be used in the design of new bomb and gun sights as well as in the compilation of the firing and bombing tables so necessary for accuracy.

At Wright Field, where the Air Forces' development work is done, there are Ordnance representatives who provide the advice and assistance necessary in incorporating the best of armament in the best of airplanes. The Army Air Forces has a proving ground at Eglin Field, Fla. There all types of equipment used by the Air Forces are thoroughly service tested, and the most effective technique for using the equipment in combat is determined. The Ordnance member of the proving-ground committee and his technical helpers furnish the necessary assistance in determining if the equipment is ready for combat.

The evolution of the Ordnance troops needed by the Air Forces has paralleled the growth of the armament equipment handled by them for the Air Forces. Beginning with simple supply and technical advice during the first World War, it progressed to one Ordnance platoon at each Air Force station, and, finally, in 1940 the troops were increased to one company per group. Their work became of such volume that in February 1941 reorganization to one air-base company for each air base and one company (pursuit or bombardment) for each group of pursuit or bombardment was effected. Upon the dissolution of the G.H.Q. Air Force and the establishment of the Air Forces as an entirely separate and distinct branch of service, each combat group and each service center was assigned one or more companies, and each air force depot was assigned one company. Later, the companies with tactical units were disbanded and the work was given to Ordnance sections organically assigned to the tactical squadrons. The work of these troops must be flexible, reliable, and capable of meeting sudden, terrific demands. A good illustration is the job done by forty-eight enlisted men in the Battle of Buna. During those 3 days, these 48 men serviced bombers with 200 tons of bombs without adequate handling equipment. Frequently it has been necessary for units of maintenance companies to execute repairs on planes themselves since they are one of the few units which have machine tools available.

Another very outstanding example of resourcefulness that is so often the difference between victory and defeat happened in the Battle of the Bismarck Sea. In the absence of proper fuzes for minimum-altitude bombing, the Ordnance personnel in New Guinea modified enough of the available fuzes to equip all the bombs dropped by these tactics during the night before this unparalleled victory.

An invaluable tactical development that proved to be so deadly in the Battle of the Bismarck Sea was bombing from the lowest altitude at which the attacking plane can be flown and still clear obstructions. The object of the attack known as minimum-altitude bombing is to fly at maximum speed and release the bomb so that it hits the side of the target. The general principles were conceived by the Ordnance member of the proving-ground committee, and the development to combat stages was performed by the proving-ground command. New-type fuzes were required, giving longer than normal delay and allowing the plane to reach a safe distance before exploding the bomb. A sight that could be used by the pilot was necessary. This was accomplished by modifying the present gun sight. Such ingenuity is responsible for the fact that not one of the twenty-two ships in the Japanese convoy in the Bismarck Sea was known to have escaped destruction.

IF you will glance into the near future you can see a very different picture than the one of today. The bombers will dwarf our present Flying Fortresses. They will carry half a carload of bombs across the Atlantic and fly home without stop. The bomber's skin will have numerous blisters which in reality will be multiple-gun power turrets controllable from sighting stations. Sights that compensate for almost every possible error encountered in firing on a fast-moving aërial target will control the guns—a sight as revolutionary as our present bomb sight. The plane will have "eyes" that help guide it to its target or warn and plot the course of interceptor aircraft. It will carry bombs of an entirely different design. It may mount heavy-caliber cannon of an entirely new principle of operation. Fighter planes will have advanced almost beyond recognition in form and in the combat equipment they carry.

Such imminent developments as these are taking the coordinated hard work of many organizations. The Ordnance Department plays a very important part in making these planes military, and judging from the past it is certain that the Ordnance Department and the many private concerns who work so closely with it will have the bombs, guns, cannon, and other weapons ready when the airplanes of tomorrow come off the production lines.

"Keep 'Em Shooting!"

Supply and Maintenance of Weapons in the Service Commands

Maj. Gen. Levin H. Campbell, Jr.

THE Service Commands and the Ordnance Department have a common understanding of the necessity of giving to the troops that same opportunity to learn supply and maintenance as to train for combat. We have a common duty to serve the Ground Forces and the Air Forces. We must instill in our people in the posts, camps, and stations complete understanding of how we carry on the business of Ordnance supply and maintenance to give the Ground Forces and Air Forces the best service.

We cannot and must not approach our problem in the light of geographical boundaries alone. Within the Zone of the Interior we are organized geographically as Service Commands. But the practicalities of training require the constant shifting of combat forces across Service Command boundaries. It is our responsibility to see that in this necessary shifting the troops are not confronted with different methods of executing the Ordnance procedures and doctrines laid down for the purpose of serving them.

It is axiomatic that the results of indoctrination methods practiced upon youth remain when the time comes for the application of those doctrines under the stress of actualities. In our effort to educate the troops how best to use Ordnance systems of supply and maintenance let us not find ourselves guilty of confusing them. More important still, we want to encourage them to know and use the field system of supply and maintenance. If we could thereby work ourselves out of our jobs, we would know that the troops were trained in supply and maintenance.

We have another responsibility. War requires that there be no small degree of improvisation in a theater of operations. There are those delays and unexpected emergencies caused by enemy action, and there are times when only improvisation can take the place of the best laid plans gone awry. No man may be expected to improvise unless he has first learned the lesson of what his improvisation is to supplant.

Perhaps more for euphony than for any other reason we in Ordnance speak in the sequence of "supply and maintenance." The two functions are so related and so interdependent that it is questionable which is the more important. Supply is a means toward an end; the objective, after initial troop needs are filled, is certainly to maintain the equipment of the using troops at the highest pitch of combat efficiency.

WE have gone far along the road of standardizing the supply system, and yet there is much more still to be done which can be done only with the full coöperation of the Service Commands. We of Ordnance must work through the Service Commands with their points of contact with the ultimate consumer, the using troops. We can accomplish the objective better when we are doing the same things in the ways that have been determined best through the test of experience. We must at all times be in agreement on the best ways.

General Campbell is Chief of Ordnance of the U. S. Army.

Nothing is more disastrous to supply than lack of stock control. Nothing makes a scarcity of parts appear more like a complete lack of parts than inability to know where the stock can be found. Stock control means maintenance of a balanced stock to accomodate varied or unbalanced demands and is the tool which insures an adequate amount of supplies at the proper place and time without wasting material, time, space, and effort through overstockage.

IN our Ordnance depots we have been able to approach a high degree of efficiency in stock control, in the rearrangement of our warehouses, and in the handling of requisitions. A parallel system is in use in one or two of the Service Commands with a success that has been revealing in its effectiveness in making supplies more readily accessible to the using organizations. But we have not yet reached our full efficiency or effectiveness. We can reach that goal through full utilization by the Service Command supply points of the services of the highly trained depot experts of the Ordnance Department who must work in conjunction with the chief of the Service Command supply division and the Service Command Ordnance officer for the better distribution of spare parts, tools, and equipment. To each of these highly trained depot experts operating for the Commanding General, Army Service Forces, out of his Ordnance office, is or will be assigned a number of Service Command supply points.

The job of these experts includes the responsibility of discovering shortages and excesses and assisting in the recapture for depots of unneeded supplies of critical parts. It is important to keep constantly in mind that these men are equipped with a broad knowledge of all Ordnance parts usages and requirements and that they are capable of giving the best assistance and advice concerning parts problems not only for automotive items but also for "shooting ordnance." Perhaps the "glamor" of mobility has here and there given a little too much emphasis to parts supply for automotive equipment, but all of us should keep constantly in mind that there are also problems of parts and equipment supply for artillery, small arms, and fire control. Supply and maintenance in this field must be brought to a high level of efficiency.

This shift away from a consideration of the Ordnance supply problem merely along product lines to a broader conception of concentrating under the authority of one competent individual the responsibility of servicing all Ordnance matériel has been so successful that to question its effectiveness today would be to show a lack of understanding of the problem.

One of the features in supply which primarily concerns Ordnance but in which it may be that the Service Commanders by their contact with various combat-unit commanders may be able to assist, is the matter of what we call the *"Blitz."* By this we mean we are often ordered at various depots to make large shipments with practically no notice and very little time allowed to complete the shipment.

Ordnance Soldiers Learn Tank Maintenance

This M2A3 tank was disabled in a plunge over a rocky ledge. Ordnance maintenance crews, being trained in tank recovery at the Ordnance Unit Training Center, Camp Perry, Ohio, first inspect the vehicle for simulated booby traps as shown above. The tank is then righted, the tracks replaced, and it is towed to level ground by a heavy wrecker as illustrated below.

Several of our depot commanders have been forced to meet such situations by maintaining a reserve of personnel. This obviously is costly not only in money but in man power. We realize that occasionally it is not possible to give ample notice. We likewise know that in most cases it is. Any assistance which the Service Commands can give in this regard will inure to the advantage of the whole.

In those Service Commands where the energies of the chief of the supply division and of the Ordnance officer have been jointly directed toward the development and full utilization of the system of unification and standardization of processes between depots and supply points, the results have been uniformly good. Significantly, while the general improvement has been marked, there have been distinctly different outstanding accomplishments resulting from some special talents of organization or management. In one Service Command there was developed an especially fine system for controlling availability of stock. As a consequence, the supply points in this Service Command are now filling ninety per cent of the requisitions without extracting upon the Ordnance depot. In another Service Command there has been such a complete acceptance of the Ordnance system of receiving, storing, and issuing spare parts at the supply points that it is now easy to shuttle needed parts among the supply points within that Service Command as required.

This shuttling of all Ordnance spare parts among Service Command supply points nearest to the consumer level is more important than it may appear. It keeps the strain off the Ordnance depots, none of which is, strictly speaking, a retail depot for supply-point parts. Among Ordnance depots are domestic as well as overseas depots, but the domestic depots are the places from which replenishments are drawn by the Service Command supply point, which is the "supermarket" serving an area whose stockage is based upon records of mortality and of density of major items, adjusted to a stock level of not more than thirty days.

IMPORTANT to the Ordnance Department, as to the Service Commands, is the shrinkage of transit time involved in filling requisitions as a result of the consumer's not drawing upon the base depots. This has been effected by the stock-control program which has recovered and redistributed excess stocks to Service Command supply points. This has enabled the Ordnance Department to make a smaller total stock serve more purposes than had previously been possible and has contributed to preventing the immobilization of large quantities of essential spare parts.

There are three really critical groups of supplies in the Army at the present time: parts, tools, and tires. Since the system of control and supervision executed through the Service Command supply points has been in operation there have been recovered from hoarded stocks approximately thirty million pounds of these critical groups of supplies. The dollar rate of recovery has approximated four million dollars a month. The Service Commands must face the same realities that we are facing in the Ordnance Department. The production capacity of our factories is nearly at its peak, man power is dwindling, every material which goes into the manufacture of our requirements is critical. All of us must keep in mind that American resources are not unlimited. Economy should be our constant preoccupation.

Before turning to the subject of maintenance it would be well to consider the improvement made in many Service Commands in their relationships with the Army Ground Forces and the Army Air Forces—the people with whom we do business—because of the service which the Ordnance representatives have been able to render them, working through the supply points. Both the Army Ground Forces and the Army Air Forces have found that the Ordnance representatives have anticipated their needs, instructed troops in how to make repairs, how to order spare parts, and, above all, how to make out requisitions in such a way that they are readily translated at the Service Command supply points into speedy shipment of their requirements.

In maintenance we are principally concerned with the fusion of spare parts, tools, and equipment with man power. The end purpose of Ordnance procurement, production, and supply is to be certain that, through proper maintenance, tanks roll, trucks run, and guns shoot.

IT may be of interest at this point to insert a statement of the basic shop organization of maintenance as at present in force. The Service Commands have under them all the post and Service Command shops. The post shops principally take care of maintenance up through the third echelon. The Service Command shops handle the fourth echelon of maintenance. The base shops perform fifth-echelon maintenance and operate directly under the Chief of Ordnance. Nine of these shops are engaged primarily in automotive work and eleven primarily on Ordnance armament work including guns, carriages of all types, fire-control instruments, etc. The Commanding General of the Army Service Forces has ruled that the Chief of Ordnance, acting as his staff officer, has full authority through the Service Commanders to control the policies on the operations of all shops, and the Chief of Ordnance is responsible to him for the efficient operation of these shops. In other words, the Service Commanders and the Chief of Ordnance are a team operating these shops for the Commanding General of the Army Service Forces.

Within the realm of maintenance, perhaps even more than in supply, the necessity for uniformity of methods applies. Here specialization is important, and with that must go a recognition that to do its best job each echelon must not extend itself beyond its ability to perform nor beyond the limits of the tools and equipment available for the job assigned to it. One of the disastrous effects upon the Ordnance system of maintenance has been the attempt by the lower echelons of maintenance to extend themselves beyond the limits of their missions. Perhaps in no other place in the Army is it as essential for each echelon to stay in its own back yard as it is in maintenance.

The chief of the Ordnance branch of the Service Command has a heavy responsibility not only to see that the Service Command shops live up to the performance required of them but also to offer and make available to the Army Ground Forces Ordnance maintenance units all possible assistance for the training of organic maintenance units so that upon their departure there will not be the slightest doubt as to their readiness and ability to do the heavy job that will be required of them later.

The responsibility for inspection, modification, and maintenance of ordnance matériel in the hands of the Army Ground Forces is clearly defined in War Department circulars, Ordnance field-service bulletins, and other directives.

Uniformity of methods in all Service Commands is vital. In the interest of such uniformity it may be well to dwell for a few moments upon what my assistants in the Ordnance Field Service consider a clear exposition of responsibility.

Tank Recovery Is an Ordnance Specialty

Typical of the recovery problems being solved daily by Ordnance maintenance crews is the one illustrated above—an M3 medium tank "hull down" in mud with a track thrown. Ordnance soldiers will attach chains and cables, and the mired vehicle will be pulled to solid ground by the winch of a powerful wrecking truck as shown in the photograph below.

The performance of technical inspections, modifications, and third- and fourth-echelon maintenance of ordnance matériel in the hands of Army Ground Forces and Army Air Forces units is the responsibility of the maintenance units (companies and battalions) of the Ground Forces and Air Forces. The Service Command is directly responsible for the performance of these functions on all ordnance matériel pertaining to the troops and activities under its control. In addition, the Service Command is responsible for the performance of these functions on ordnance matériel of the Ground Forces and Air Forces wherever Ordnance maintenance units of these combat troops are unable to perform them due to lack of qualified personnel or adequate facilities. This responsibility within the Service Command should rest with the chief of the Ordnance branch and be made effective through the commanding officers of the Class II stations in the Service Command.

Where no combat maintenance unit is assigned for the maintenance of the ordnance matériel of a tactical organization, the chief of the Ordnance branch should be directly responsible for these functions, unless specific instructions to the contrary are received. Where a combat-force Ordnance maintenance company is available and has been assigned these functions, the chief of the Ordnance branch should be charged with maintaining close contact with the commanding officer of that maintenance unit to insure that the latter fully understands that the Ordnance personnel and facilities in the post are available at all times to assist in every way in the performance of these functions to the end that inspection, modification, and maintenance work may be completed promptly as required.

The chief of the Ordnance branch should make available to the commanding officer of all combat Ordnance maintenance units qualified mechanics to act as instructors or permit individuals or groups of men of the organization to perform work in the post Ordnance shops under the supervision of qualified mechanics of the post Ordnance shops.

The commanding officer of each Service Command Ordnance shop should also offer every assistance in training Ordnance maintenance organizations and tender the facilities of his shop for that purpose. If additional skilled mechanics are needed at any station for short periods in order to accomplish the mission, Service Command headquarters should be requested to furnish them on temporary-duty status.

ONE of the greatest difficulties which Ordnance Field Service has experienced in equipping organizations in the Zone of Interior has been the large number of vehicles immobilized at Service Command shops awaiting overhaul. To minimize this condition and to provide maintenance training for troops in the field, the issue of unprocessed vehicles was authorized in a supply memorandum regarding the repair of vehicles turned in by units.

A recent check in the field discloses that the instructions with regard to the issue of unprocessed vehicles are not being fully complied with and that a considerable number of vehicles are still immobilized at Service Command shops.

This situation is due, I am afraid, to the fact that our shop officers have become perfectionists and are laudably trying to turn out of their shops equipment repaired to a perfection standard. There should be some happy solution short of perfection which will satisfy troop commanders that they are being issued overhauled equipment in which they can take pride, particularly in appearance. This is largely a problem for Service Commanders. A faster turnover of vehicles through the shops should keep to a minimum the number required for the Zone of Interior.

With reference to new vehicles delivered to the Service Command for distribution, it appears that considerable unnecessary work, consuming man-hours and holding up equipment, is being done in the inspection of vehicles before delivery, notwithstanding the fact that the vehicles presumably have been properly inspected and accepted at the source of manufacture by Government inspectors. It would appear that such work on the part of Service Commands with new vehicles is unnecessary, and the only inspection prior to delivery should be more or less superficial to determine that the vehicle will start, run, and stop, and to check such items as lights, horn, battery, water in radiator, oil in crankcase, and on-vehicle tools and equipment.

It is important that those in charge of the Service Command shops remember that the practice of attempting to do the fifth-echelon work designated for the base shops should be discontinued. Here, more than among other echelons, is the line of demarcation least observed. Most Service Command shops have neither the equipment nor qualified personnel to complete properly the general overhaul and rebuild of engines and to give the vehicles the tests required before they can go back into service. The practice of Service Command shops attempting to do work beyond their capacity to perform must not be permitted to continue.

NO end of confusion exists as the result of the laxity of supervision over the manner in which unit assemblies are forwarded to base shops in salvaged crates from which the shipping organization has not obliterated the old markings. The seriousness of the situation is mingled with a little amusement. Not infrequently matériel arrives in crates which show other destinations, such as China or Russia, depending upon which side of the crate the commercial carrier reads. At one base-shop receiving department there was recently received a heavy box which, according to the lettering, should have contained "Smoked Sausages." Only by opening the crate was it possible to ascertain that instead of that country delicacy it contained only used parts from the Ordnance Service Command shop at a not-too-distant post.

I have already mentioned the conservation of critical material through the control of spare-parts distribution, thereby taking the burden off the production facilities. No less important is the conservation and salvage of critical material through reclamation going on in all Ordnance base shops. In one Ordnance base shop the total value of reclaimed material amounted to $250,000 in the month of June alone, and the savings in critical materials and hard-to-obtain parts are beyond the scope of dollar valuation. Aside from reclamation through already recognized rebuild and repair processes, much of this saving is a discovery of continued uses for obsolete parts and the rescue from the scrap heap of items needing only cleaning and adjustment, plus the development of reclamation processes which have in peacetime been discouraged by easy replacement.

With little effort and no great amount of time involved, some of this reclaimed material has been found usable in vehicles of other makes. Crankshafts, connecting rods, valves, push rods, timing gears, water-pump assemblies, and timing-gear covers from Hercules JXC engines in old Federal trucks are usable in JXD's in current scout cars. Obsolete Plymouth

and Dodge engines are being converted to current models by installing front motor supports and bell housings—the Dodge T-76 is changed to a T-203 by changing the front support only. The Plymouth PT 105 is interchangeable with the T-202 Dodge. The list is long but it is indicative of what both the Service Commands and Ordnance must do in the way of improvising new uses for things that would otherwise be wasted or scrapped.

A requirement which Service Commands must follow is that for proper packing and tagging of shipments from posts, camps, and stations in accordance with AR 850-15. In a recent shipment from one unit, innumerable items were thrown haphazardly into boxes without any wrapping whatever. One box alone contained seventy-eight pieces of fifty-six different items. Naturally, with so many items dumped at random into one large box, much of the equipment was damaged during transit. In addition, because the unit failed to tag the items, the entire shipment had to be segregated and identified by the base shop at a considerable expense of time and man power.

THE automotive-disability reports required by the Inspector General's Department are the barometric readings of how well the job of maintenance is being carried on within the Service Commands and how thoroughly we in Ordnance are fulfilling our obligation of supply. I am glad to say that the trend is distinctly better. The disability reports show a progressive lowering of dead-line percentages. We must not, however, become complacent. There is still much to be done in better supervision of the shops by the Service Commands and in concerted efforts of both the Service Commands and the Ordnance Department on the matter of parts distribution. I have previously outlined the Ordnance rôle in getting the parts down nearer to the using organizations and the elimination of the transit time in getting parts supplied. If, however, we are going to accomplish greater improvement in removing vehicles from the dead line within the time allowed by the Inspector General so that the combat forces will be able to muster their full mobile strength on short notice, then the Service Commands must see to it that the time between determination of the parts needed, the making out of requisitions, and the forwarding of the requisitions to parts warehouses, is materially shortened.

Much has been done and more can be done by the Service Commands to overcome the dead-line problem. Copies of the vehicle dead-line reports are mailed from the using organizations to the Service Commands simultaneously with the mailing of the report to the Inspector General on the 16th of each month. If the Service Commands will study these reports and take immediate corrective action, great strides are possible in getting immediate results with the units which report with too-frequent regularity a more-than-normal percentage of vehicles dead-lined each month. If the fault rests with the Ordnance supply system we should be informed so that corrective action may be taken. If investigation discloses, as is generally believed, that the fault lies in the improper preparation of requisitions by troops, then the Service Commands have an indoctrination job to do and should waste no time in doing it. The post Ordnance officers can do more in a half-hour visit to the units than they can accomplish in four hours of writing letters or by merely returning unfilled, incorrectly prepared requisitions.

The pressure which has been on every one to improve automotive equipment has brought results, but I am sorry to say that there seems to have been an apparent laxity in the maintenance of armament, as is indicated by reports of the Inspector General's groups going over the equipment of alerted units. Where troops do not have to shoot in maneuvers, they are likely to forget that shooting ordnance has to be constantly cared for. It is a serious matter to permit troops to leave their home stations bound overseas without their armament being serviceable and without the modifications called for having been performed.

UNDER the circular dealing with preparation for overseas movement, the responsibility is upon the station commander under the Service Command to assist the unit commander in conducting showdown inspections and to be sure of the completeness and combat serviceability of equipment. It is not sufficient to attempt to do this two or three days before a unit moves out. That is too late. The time to get on top of the job is when the alert is given. Coincidentally with that action, it must be ascertained whether the modifications, many of which are in the interests of safety, have been made.

The Army Service Forces is endeavoring to equip departing units with new or reasonably new equipment at ports of embarkation and if not there upon their arrival overseas. This will result in the units leaving at the ports such poorly maintained or improperly modified armament as the Service Commands have failed to check before their departure from stations under their command. Therefore, if the Service Commands do not keep constantly nudging the units to maintain their equipment in serviceable condition the Commands will find themselves confronted with the task of inspecting, repairing, and modifying both armament and vehicles that should have been carried on before the units moved out. Such a condition can only multiply our difficulties.

Let us shake ourselves and remember that this war is a long way from being over. We have just begun to fight. The responsibility of the Service Commands is to service the troops in training and about to depart for theaters of operation. Their destinations are varied; the problems which they will face are complex. The finger is upon all of us and we must drive every responsible officer under our commands to the full capacity of his ability to perform. We must load onto our supply, maintenance, and inspection crews all the burdens which they can carry and demand more if we are not to fail in trust or responsibility.

EDITOR'S NOTE.—Addressing the American Iron and Steel Institute in New York City recently, General Campbell said: "We have accomplished more in two years than has Germany in ten and Japan in thirty. Our guns, armor plate, and projectiles are being produced in enormous quantities by mass-production methods once considered inadequate. They are of unsurpassed quality and yet contain much less alloy than could have been dreamed possible as little as two years ago.

"We have borrowed freely from the experience of peacetime industry, where it appeared that such would be to our advantage. We now make some guns in a tube mill. We cast others centrifugally, a process developed by Watertown Arsenal. We have adopted flame-hardening techniques for tank sprockets, wrist pins, and cams. Worn parts are reclaimed by metal spraying. Experiments with powder metallurgy are approaching the period of fruition. Advances have been made in plating and other types of metal coating."

Our Weapons in North Africa

Impressions from an Inspection Tour of the Fighting Front

Maj. Gen. G. M. Barnes

I HAVE been in close contact through the years with the work which has been done by our Army Ordnance Association. The Association worked to bring to American industry an understanding of the important part which it must play in a war emergency. Our Association accomplished a great task in bringing American industry and the Army Ordnance Department into close harmony and coöperation in the prewar period. It is possible that the local Posts and the Army Ordnance Association as a whole may not make any sensational contribution to the present war effort, since the Ordnance Department now has plenty of funds and American industry is engaged in the mass production of munitions. But as soon as the war ends—and this war, like all others, will come to an end—the old problems which beset us prior to 1939 again will be present. The opportunity then will arise for this and all other local Posts of the Army Ordnance Association to impress upon the American people the importance and necessity of industrial mobilization as a means for insuring national safety.

It has been suggested that I should tell you about the trip which I made last winter to the North African battlefields and evaluate the performance of our ordnance equipment in that theater. At the same time, I would like to speak briefly of the trip itself, because this long air voyage of some 30,000 miles made a deep impression upon me, and I gained a better understanding of the tremendous distances involved in this global warfare in which we now are engaged.

I was fortunate enough to be ordered by the War Department to join the party headed by Lieut. Gen. Jacob L. Devers, who at that time was Chief of the Armored Force at Fort Knox, Ky. Many of you personally know General Devers, who has since been transferred to London as head of the American forces in that theater. Accompanying General Devers were Maj. Gen. Edward H. Brooks and Brig. Gen. W. P. Palmer of the Armored Force; Col. W. T. Sexton, Office of the Deputy Chief of Staff; and Maj. Earl L. Hormel, Air Corps liaison officer with the Armored Force.

The party left Washington on December 14, 1942. I remember that it was a very cold day with the temperature around 12 degrees with snow and a biting wind. The plane had difficulty in starting, due to the cold, and did not take off until about 2 o'clock in the afternoon. Later that day we arrived at West Palm Beach, Fla., where we had dinner, and the plane was fueled. In the evening we started for South America. Next morning as we looked down we saw that we were over the great jungle country of Venezuela with a solid mat of trees extending for hundreds of miles without a single break as far as the eye could reach. I wondered how a plane could make an emergency landing and how, if you succeeded in reaching the ground, you could make your way back to civilization out of that great forest. Nevertheless, we know that men have been able to do exactly that. We did not have any difficulty, and about 8 o'clock we were hovering over an airfield cut in the jungle.

Landing here we found that we were in a truly tropical climate and were glad to put on cotton uniforms. We went for breakfast to the officers' quarters in temporary buildings built in the characteristic tropical manner on tall poles. These houses were screened and double screened and the whole camp was constructed in accordance with the best Army sanitary regulations. After breakfast we took off again and flew over that great expanse of country we know as Brazil. This country was very similar from the air to Venezuela, except that we passed many streams flowing into the ocean. That night after dark we occasionally could see the lights of small widely scattered villages. Finally, we arrived at Natal where we stayed overnight in order to give our aviators a rest and to have the plane serviced. We had the opportunity the following day to visit the city of Natal, which is a characteristic South American town and a very good seaport.

After supper we took off again, this time across the ocean, flying all night at a rather high altitude above the clouds. In the morning we pushed down through these clouds and were happy to see directly in front of us a small island. This island appeared as a single mountain peak, and as we drew near we could see a small village located to one side.

In the afternoon we landed at a West African base. Here they gave us various medicines to ward off malaria and we were told that in the evening we should wear our mosquito boots. Mosquito boots are high leather shoes extending half way to the knees with draw strings at the top. Apparently, malaria mosquitoes are most likely to bite one on the ankles. We slept that night under mosquito bars. The natives of Accra are coal-black and one does not realize how light the colored people in the United States have become by comparison. These natives also walk with a quite vigorous step and have a magnificent carriage. I found that their erect posture is due to the fact that they carry all of their loads on their heads.

We next flew across the jungle country of Africa and in the middle of the afternoon arrived at a very old city in Nigeria. As we were not flying again until the evening, we had the opportunity to visit this ancient city, many centuries old. It covers approximately twenty-five square miles and is completely enclosed by an earthen wall which was originally sixty feet high but which has eroded to a height of about ten or twelve feet. The houses in the city are exactly like those illustrated in your Bible. From a distance the city looks attractive but not on close inspection. The houses are without windows, doors, or floors. The people have no utensils of any kind and live in indescribable squalor. The natives wear rags of any sort and, of course, are all barefoot.

This evening we flew again over the African wastelands and in the bright moonlight could see Lake Chadd. In the

---

General Barnes is chief of the Technical Division of the Ordnance Department, U. S. Army. This is an address delivered by General Barnes before the Detroit Post of the Army Ordnance Association, Detroit, Mich.

morning we passed over mile after mile of endless white desert and then suddenly came to the valley of the Nile, beautiful by contrast. About 8 o'clock we landed at Khartoum. After a brief stop here, we flew down the Nile valley with the desert at each side of a rather narrow strip of fertile land and finally arrived at 2 o'clock in the afternoon at the ancient center of Egyptian civilization, Cairo.

Our party immediately began a series of conferences with American and British officials. Lieut. Gen. Frank M. Andrews at the time was in command of the American forces in this theater. As you know, General Andrews was later transferred in command of the American forces in the British Isles and was killed on a trip to Iceland—a great loss to the Army and especially to the Air Forces. General Devers has recently taken General Andrews' place in command of the American forces in the British Isles. Other American officers were Maj. Gen. Russell L. Maxwell of the Ordnance Department, who had been in charge of this theater up until the time that General Andrews arrived, and Maj. Gen. Lewis H. Brereton, who was in charge of the Air Forces.

Here we first encountered the very pleasant news of the outstanding performance of the American M3 light and the M3 medium tank, which the British call the "General Grant." Most of the officers with whom we talked had been in many of the battles back and forth across the Libyan Desert. These officers stated that it was the M3 medium tank which made it possible for them to stop Rommel in his powerful drive toward Alexandria and Cairo. The Germans then had encountered a tank which was, first of all, very reliable in its operation and whose armor was difficult to pierce. Above all, it was armed with a high-power 75-mm. gun. Fortunately, these M3 American tanks had arrived on time and in sufficient quantity to be effective. When the automotive industry of Detroit and the plants throughout the United States were working day and night to produce the M3 tank, none of us realized the great influence which this weapon would have on the history of the African campaign.

THE M4 Sherman tanks soon began to arrive in sufficient quantity to make it possible for General Montgomery to give thought to a serious offensive against the Germans after they had been stopped at the Qattara Depression. These M4 tanks were taken from our own forces in training and sent in great haste to Africa. Moreover, production of those plants engaged in the manufacture of the M4 tank rapidly increased day by day. In planning the battles, General Montgomery displayed great leadership. He deliberately built up a large park of trucks and other automotive vehicles close by the German lines in a carefully selected position. As he expected, the Germans soon flew over this position and carefully photographed it. Their studies of the photographs revealed that this was nothing but a large concentration of commercial trucks, and the Germans therefore paid no attention to the park. General Montgomery, as the M4's arrived, gradually sent them at night to the front carefully camouflaged and put them into this park, withdrawing an equal number of trucks. In this way he was able to build up a great striking force of M4 Sherman tanks under the very noses of the German Africa Korps.

All of you have read about the great artillery barrage which was laid down over the German positions, but less has been written about the great tank struggle which took place at the Battle of El Alamein. The Germans brought up their large tank force at one stage of this battle, as General Montgomery had anticipated they would. When they arrived at the proper position, General Montgomery pulled the camouflage coverings from his M4 tanks and opened a devastating fire. In a few moments Rommel had lost over one-half his entire armored force. There was then nothing for him to do but to turn around and flee with all possible speed back across the desert. As you will remember, Marshal Rommel was closely pursued by these British forces with light and medium tanks and barely escaped on several occasions.

After our party left Cairo we flew over the position of the El Alamein battle in the Qattara Depression and had the opportunity to study the ground and the paths along which Rommel and his army retreated. It is difficult to understand the completeness of the defeat of the German Afrika Korps unless one has seen the thousands of wrecked tanks, trucks, and planes which are spread over the desert all the way from the El Alamein position past Tobruk and Benghazi—in fact for hundreds of miles toward the Tunisian border.

AFTER leaving the battlefield of El Alamein, our party flew to the vicinity of Benghazi, where we joined the headquarters of the British Eighth Army, then engaged in pushing Rommel into Tunisia. We had the opportunity to visit the city—the first I had ever seen which had been completely destroyed from the air. Benghazi apparently at one time had been a pleasant coastal city with broad streets and attractive buildings, but it has now been completely destroyed and is a city of the dead. The British Army had, however, partially cleared the port, which was then in operation. All the supplies for the Eighth Army were being forwarded from Benghazi by road up to the front, which was then forward of Marble Arch. The double line of trucks going back and forth from Benghazi for hundreds of miles across the desert to the positions of the British lines was a sight to behold.

Later, we flew to Marble Arch and while there stayed at General Alexander's headquarters. General Devers held conferences with General Alexander, General Montgomery, and other ranking officers of the Eighth Army. In addition, we talked to colonels, majors, lieutenants, sergeants, and privates who were with their organizations at the front. I remember particularly talking with General Alexander, who was in supreme command of the North African theater. General Montgomery was in active command of the troops. General Alexander, who impressed me as being a very fine soldier, stated that there are three main factors which determine victory in modern warfare. The first factor is *leadership*. We all remember instances in which the finest armies have been defeated due to lack of leadership or the lack of confidence of the troops in their leaders. The second factor for victory is *matériel*. General Alexander stated that a modern army is helpless unless it has matériel of the proper quality and in the quantities required for war. He further stated that an army which lacks proper matériel will fail even under the best leadership. The third factor to which he referred was *training*. Obviously, effective training of a modern army is necessary if proper use is to be made of the complicated panoply of war.

At the time of our visit, General Alexander and General Montgomery were very much disturbed about the use of antitank mines by the Germans. The Germans had laid an incredibly large number of mines along the path of their retreating armies. Hundreds of thousands of German mines

Signal Corps

TANK-RECOVERY UNITS, SUCH AS THAT ABOVE, PLAYED AN IMPORTANT PART IN THE NORTH AFRICAN VICTORY

were laid everywhere across the desert. Consequently, it was necessary for the British Eighth Army to feel its way carefully along the roads and across the sands. It was necessary for them to take the time to detect these mines and to remove them, ahead of the march of their trucks and armored fighting vehicles, otherwise the losses would have been serious. However, many devices have been designed for defeating the German antitank mines, and this problem is now under control.

The Germans also were very expert in improvising booby traps. Officers and men had to be very wary of touching anything on the desert to which a booby trap might be attached. At the time of our visit, a number of officers and men had been killed in this way. As an example of the extreme ends to which the Germans went in devising these traps, a story was told of a British major of engineers who came upon an abandoned German dugout. Across the entrance of the dugout a fine wire had been stretched. The major attached a light string to this wire and backed off, looking for safe cover. Nearby was a slit trench in which he stationed himself and his men. From this cover he pulled the string, and the slit trench exploded, killing the entire detail.

Our party had the opportunity of visiting organizations of the British Eighth Army located in the field. We talked with the commanding officers of regiments, as well as the junior officers, sergeants, and privates. All were most enthusiastic about their American tanks, ammunition, and all matériel which had been provided. I remember especially talking to one private who was a gun pointer in an M4 tank. He told me he had destroyed nine German tanks with his M4, some of which had been knocked out at long ranges. I was particularly interested in the sighting mechanism of our tanks at that time, which we were seeking to improve. I asked this gun pointer how he would like to have the sight changed. His reply was, "The sight is good enough. Please leave it alone."

The British officers and men were also very enthusiastic about the 105-mm., M7, self-propelled mount which they call the "Priest," a number of which had been engaged in the Battle of El Alamein and in the subsequent battles across the desert. They had many tales to tell of the great effectiveness of this weapon, stating that in some instances German tanks had been knocked out at ranges of up to five miles.

AFTER leaving General Alexander's headquarters, we flew on a long overnight hop south of the German forces in Tunisia and in the morning arrived at the attractive city of Algiers on the Mediterranean. Algiers at that time was the location of General Eisenhower's headquarters. After various conferences with General Eisenhower and members of his staff, our party left by car for Constantine on the way to the Tunisian front. The road to Constantine was a good road, but narrow and winding over many mountainous passes. This is the road over which our combat troops and all their matériel passed from Oran to the Tunisian front. Our equipment made a remarkable record in safely traversing these high passes and narrow roads. There was a railroad of fair capacity from Algiers to Constantine, but there was lack of rolling stock and locomotives.

At Constantine we visited the headquarters of General Anderson of the British First Army. We spent the night at Constantine and the next day traveled again over the mountains and arrived in the evening near Medjez-el-Bab on the main road to Tunis. At Medjez-el-Bab, Tunis was but thirty-five kilometers or approximately twenty miles distant. It would have been very simple to have continued down this road to Tunis into the arms of the waiting Germans.

On the Tunisian front it was very easy for us to understand the difficulties which our troops had at that time. They had gone forward over this great distance of nearly 1,000 miles from Oran to Tunis with their supplies in a very short time. In making the advance, they had progressed faster than the Air Forces could set up forward airfields from which fighter planes could be flown. One lesson which has been learned in this war is that troops cannot operate

effectively ahead of fighter-plane cover against an army equipped with aircraft. Our troops occupied a long front along the Tunisian border, and in most places an infantry company covered about one mile of front. It was very easy for the Germans to push through at any one point with an armored force until time would permit our own armored troops to gather their strength to stop the advance.

We followed the same plan in our visit as with the British Eighth Army. We located the organization and men in the field and had the opportunity to talk with them concerning their experiences with our equipment. We found them most enthusiastic about their tanks, artillery, and various other items of ordnance. They had met the Germans on many occasions, and they felt sure they could defeat them, as later proved the case.

After spending considerable time at the front we returned by automobile to Algiers and again took a plane down the Mediterranean coast to Oran with its large and excellent harbor. After leaving Oran, we flew to Casablanca. Here there was great excitement because the President was expected in a few days. Lieut. Gen. George S. Patton, Jr., was stationed at Casablanca with his corps at that time. While we were there, General Patton gave a luncheon in honor of General Devers, which was attended by leading French army and navy officers. To my mind, the most colorful figures at the luncheon were the Pasha of Casablanca and the Pasha of Marrakesh. These rulers of the Arabic people have large castles or estates in the nearby provinces and each has 400 wives. They arrived in medieval costumes carrying jeweled daggers, which they checked with the hat-check boy in the lobby of the club! During the dinner I sat next to U. S. Counselor General H. Earle Russell who had served several years at Casablanca and knew the political and military situation there thoroughly. I found later that Mr. Russell was born and lived for many years in Battle Creek, Mich.—forty miles from where I was raised as a boy.

After leaving Casablanca we flew to Scotland by way of Gibraltar and then returned from Scotland to Casablanca and Marrakesh. We flew from Marrakesh over the Atlas Mountains to Dakar. The city has a fine harbor in which there were several French battleships. These ships are now in the United States undergoing repairs. From Dakar we made a long flight over the ocean to Belém, South America. From Belém we flew to Puerto Rico, from Puerto Rico to West Palm Beach, and back to Washington.

AS you can well imagine, it would be impossible for me to give you any adequate review of all the ordnance weapons which have been utilized in the war up to date, since the Ordnance Department supplies our Army with over 1,700 major items. I can, however, review very briefly the performance of a few weapons representative of certain classes.

The infantry has been considered throughout the centuries as all-important on the battlefield, and nothing has happened in this war to deprive the infantry of this distinction. The most important weapon of the infantry is the rifle with which each soldier is equipped. The Garand rifle—the caliber .30, M1, semiautomatic shoulder rifle—is the weapon which the Ordnance Department is manufacturing for our Infantry. The important thing about the Garand rifle is that it makes each American soldier the equivalent of two Japanese soldiers as far as firepower is concerned.

We know that the United States has established a ratio in the Pacific area of five Japanese airplanes destroyed to one American, and we have read about the deadly fire of the Flying Fortresses when they encounter enemy pursuit planes. American fighting planes are armed with the caliber .50 aircraft machine gun. This weapon was developed jointly by the Ordnance Department and Colt's Patent Fire Arms Manufacturing Company over a long period of years. This gun is probably one of the most important weapons being utilized in the present war. It is not only the weapon itself which is important but also the special ammunition which has been provided to make this gun so deadly in combat against enemy planes. The caliber .50 machine gun has also been found to be a very effective weapon against low-flying German airplanes in North Africa and has made an outstanding record there.

In the antiaircraft field, the 90-mm. gun likewise has given an outstanding performance. Maj. Gen. Alexander A. Vandegrift, recently returned from Guadalcanal, stated that his Marines shot down a large number of Japanese planes from altitudes greater than 27,000 feet with this weapon. The Marines on Guadalcanal have set up the very high score of one Japanese plane for every fifty shots—a record which will be very difficult to better.

Little has been said to date about American artillery in the Tunisian campaign, except the reports issuing from the British Eighth Army concerning the accuracy and destructive power of the American 105-mm. howitzer. Our troops in Tunisia created havoc among German troops with the accuracy of their artillery fire. General McNair, recently returned from Tunisia, reports that the work of the long-range American artillery was outstanding. Many tales are coming out of Tunisia concerning the efficiency of these weapons. In one case, an American battery armed with the long-range 155-mm. howitzer reported having destroyed a German battery with the first salvo from a range of some fifteen miles.

I have already mentioned the great contribution which American tanks have made to victory in the North African campaign. The best witness for the American tank performance has been Prime Minister Winston Churchill, who stated in his recent speech before Congress that "the Sherman tank was the best tank in the desert in the year 1942, and the presence of these weapons played an appreciable part in the ruin of Rommel's army at the Battle of El Alamein and in the long pursuit which chased him back to Tunisia."

The Japanese Army is sometimes said to be an army of men. Japanese officers teach each soldier to depend upon his courage, his tenacity, and his willingness to die for the Emperor. The American soldier is taught to have confidence in the superior firepower of his weapons and that many lives can be saved through the proper application of overwhelming firepower. The Japanese Army will go down in defeat. The German Army has come to the end of the road. No longer will powerful German armies equipped with superior weapons be able to ride roughshod over weak and ill-prepared nations. The German Army now is faced by Russian, British, and American forces armed to the teeth with the most modern and effective weapons. The German Army will go down in defeat.

In the victories which have been won and which will be gained in the future, history will record the remarkable achievement of American industry in providing, in so short a time, not only our own Army but also the armies of the allies with modern fighting equipment through the application of American mass-production methods.

British Armament

A Discussion of Some of the Weapons Used in the Present Conflict

Maj. Gen. H. Rowan-Robinson

THE rifle in general use in the British Army is the No. 1 or short rifle magazine Lee-Enfield (S.M.L.E.), Mark III. It has, except for slight changes, been in the hands of the soldier in its present form for over thirty years and therefore presents no novel features. It is, needless to say, an excellent weapon. In 1914, at Mons, the Germans found its fire so rapid and effective that they reported the British battalions to be equipped with numerous machine guns. Its weight without bayonet is nine pounds, and it has a caliber of .303 inches. It has a maximum range of 2,000 yards and is very accurate up to 600 yards; that is, up to the limit of its usual tactical employment.

The Sten machine carbine is of simple design. It was introduced to supersede the Thompson submachine gun (Tommy gun) which is comparatively expensive and has to be imported from the United States. The Sten has an effective range of one hundred yards and, like other arms of this type, can be fired either from the hip (up to twenty-five yards' range) or from the shoulder, according to the conditions of the fighting. It is especially useful when on patrol and for fighting at close quarters, such as in woods and villages. Having a caliber of 9 mm., it can take the ammunition of both German and Italian guns. The magazine holds thirty rounds, and the gun will fire either single rounds or bursts.

The great increase in the defensive firepower of small arms and improvements in concealment and cover taking have necessitated a considerable extension of the close overhead support afforded to assaulting infantry. This has resulted in an enlargement in both the size and numbers of the mortars allotted to battalions. The design of British mortars is based on that of the well-known "Stokes gun" which, though simple in the extreme, proved to be one of the most valuable military discoveries of the last war.

This type of mortar consists of a cylindrical tube resting on a base plate to which it is usually attached by a ball-and-socket joint. Into the muzzle of the tube, which can be elevated at angles of forty-five to eighty degrees, rounds are loaded as rapidly as they can be fired. As the bomb reaches the end of the bore, a percussion cap on its base is struck by a steel projection in the breech and the charge is fired.

In the British service there are two such weapons: the 2-inch mortar (Fig. 4)—a platoon weapon, and the 3-inch —a battalion weapon. The 2-inch fires a 2-pound bomb; the 3-inch, a 10-pound bomb. The latter has a range of 1,600 yards and its projectile on explosion is effective radially up to 200 yards. Smoke bombs as well as high-explosive bombs can be used with all mortars. Tangent sights are used, elevation being given by means of a range scale and an elevation bubble.

The 3-inch mortar is carried with its detachment in a truck. The detachment consists of a No. 1, a driver, and a team of three. When off the vehicle, the 3-inch mortar needs three men for its transport for carries up to 200 yards. Its ammunition requires an additional man for each six rounds. The 2-inch breaks down into a 2-man load. Both are exceedingly useful and effective weapons.

The Northover projector (Fig. 3) was designed to meet the urgent need of the British Home Guard for an antitank

---

General Rowan-Robinson is the author of numerous works including "The Campaign of Liao-Yang," "Artillery—Today and Tomorrow," "Some Aspects of Mechanization," "Further Aspects of Mechanization," "Security," "A Ministry of Defense," "England, Italy, Abyssinia," "Sanctions Begone!" "Imperial Defense," "Strategy in Four Dimensions." He was chief instructor in artillery at the Royal Military Academy from 1911 to 1914; military governor of Libau, 1919; colonel commandant and G.S.O. 1, India, 1921 to 1927; inspector general of Iraqi Army, 1930 to 1934. He was engaged in operations in Southern Kurdistan from 1930 to 1931; North Kurdistan, 1932. He is a battalion commander, British Home Guard; Gold and Silver Medalist, Royal Artillery Institution; Gold Medalist, and first and second Trench-Gascoigne Prize Essayist, Royal United Service Institution. He is a major general in the British Army and is a Companion of the Bath, of the Order of St. Michael and St. George, and holds the Distinguished Service Order.

The illustrations in this article are from British official photographs.

weapon at a time when that organization had nothing but the rifle with which to counter armored attack in case of an invasion of Britain. It is simple in design, economical of metal, and lends itself to rapid production. The basic structure consists of base plate, legs, and feet—totaling sixty pounds in weight—and the superstructure of barrel, breech equipment, and pivot, weighing seventy-four pounds. It has an all-around traverse, an effective range of 150 yards, and a maximum range of 300 yards. It can be manhandled for short distances as a 2-man load, and it is generally employed in the defense of villages, especially to cover likely tank approaches. It can fire grenades of various types, but its normal projectile is a self-igniting phosphorus bomb contained in a glass bottle.

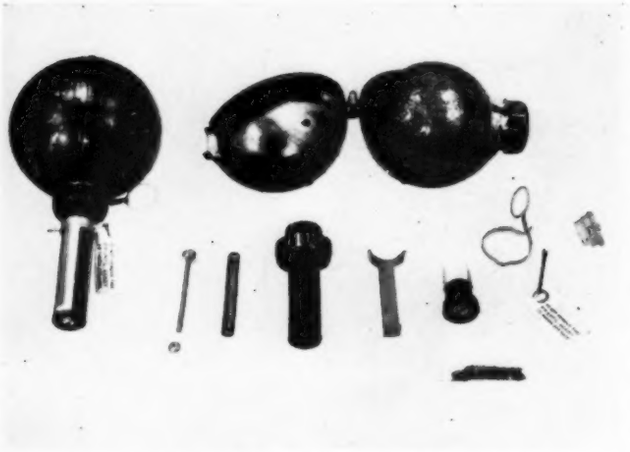


FIG. 1. No. 74 STICKY GRENADE DISASSEMBLED

At the muzzle of the projector is mounted a circular fore sight and at the breech a back sight with 6 circular apertures to give ranges from 25 to 200 yards. Owing to the vulnerability of the projector and its detachment, it is particularly important that the first round shall either blind or disable a tank. To meet this requirement, some Northovers have been given a second barrel. This arrangement also covers the risk of a misfire or premature and normally allows two rounds to be fired almost simultaneously. For action against low-flying aircraft, a somewhat higher stand can be used than the one shown in the illustration.

The author once invited the inventor to carry out a personal demonstration for the benefit of the Home Guard. Major Northover not only did some good shooting, but also, without unhappy results, deliberately committed every crime known to the gunner, such as double shotting, treble shotting, not fully closing the breech, and firing a round when a premature was burning in the bore. Never, apparently, was there a weapon so foolproof.

THE principal grenades used in the British service are Nos. 36 (Mills), 68, 69, 73, 74 (sticky bomb), and 75. The Mills grenade is a veteran of twenty-seven years' standing. It has a range, thrown, of 25 to 35 yards; fired from a rifle-discharger, of 200 yards. In the one case, it is timed to burst in four seconds; in the other, in seven seconds. It is useful mainly against personnel for any kind of close fighting, but the thrower must first be sure that he and his comrades are under cover or lying flat on the ground.

The No. 68 is an antitank projectile weighing 1¾ pounds. It is fired from a discharger with a range of fifty to seventy-five yards, a ballistite cartridge being used. The grenade consists of two parts—the body, which contains a high-explosive charge, and the tail unit. The tail unit, which is fitted with vanes to maintain steady flight, contains a hollow central sleeve in which a striker and creep spring are situated. The striker is kept in position by a safety pin and a shear wire. Before firing, the pin is withdrawn. On firing, the shear wire is broken by the shock of discharge, and on impact the striker overcomes the creep spring, hits the detonator, and explodes the grenade.

The No. 69 is a light hand grenade useful for offensive action, especially in the case of patrols. Its area of burst is small and it can therefore be thrown standing in the open. The grenade is made of plastic material and is filled with high explosive. It weighs three-quarters of a pound. On top is a safety cap below which is a mechanism holder containing a ball, striker, and creep spring together with a cap holder and cap. A safety bolt passes through the striker and mechanism holder, thus keeping the striker in position. The bolt is attached to a length of tape which is wound around the mechanism holder and has at its end a leaden weight. Through the center of the grenade runs a sleeve into which, before action, the detonator has to be inserted after removing the base plug. After the safety cap has been removed, the tape is held in place by forefinger and thumb. When the grenade is thrown, the weight causes the tape to unwind and pull out the safety bolt. On impact, the striker overcomes the resistance of the creep spring and hits the cap, thus igniting the detonator and exploding the grenade.

The No. 73 is an antitank grenade weighing four pounds and intended for use mainly in road blocks and ambushes. Owing to its weight, the maximum throw is about fifteen yards. The mechanism closely resembles that of the No. 69 grenade.

The No. 74 S. T. or sticky grenade (Fig. 1) is also intended for action against tanks. It is designed to stick to the target, but will not do so on a sloping surface should the surface be wet, muddy, or oily. Like the No. 73, it is suitable for use in road blocks and ambushes, and it can be conveniently dropped from windows in street fighting. It can be thrown, but far better effect is obtained when it is planted by hand on vulnerable parts of a tank or on the loopholes and doors of pillboxes. This method is normal to night raids on tank harbors. The body of the grenade, which consists of a flask, is protected, for transport and storage, by a metal casing hinged at the bottom and held in position around the neck of the flask by a pin or clip. To make it adhere, the

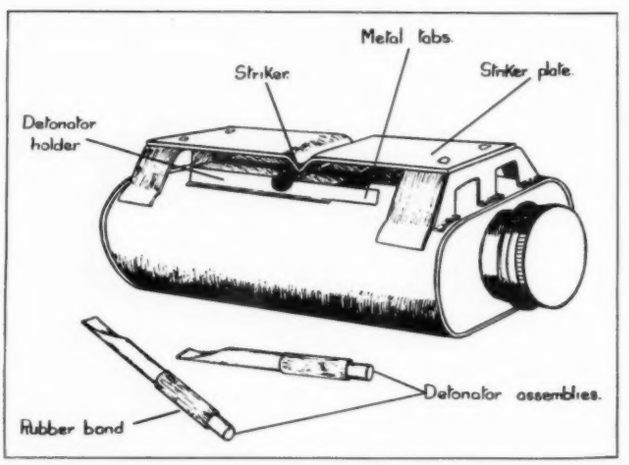


FIG. 2. No. 75 ANTITANK MINE

flask is covered with a sticky envelope. Inside the neck of the flask is a tube to hold the detonator assembly. The throwing handle is attached to the neck of the flask by a screwed ring. It contains the striker and the striker spring held in place by a lever fitting flush with the side of the handle, the lever being secured by a safety pin. The detonator assembly consists of a percussion cap, a length of fuze which burns for five seconds, a detonator, and an exploding pellet.

As a preliminary to use, the outer casing must be removed by pulling out the pin or clip at the neck of the flask. For action, the safety pin is withdrawn, thus freeing the lever which, with the striker, is held in place as long as the hand retains a grasp on it. On throwing the grenade, the lever is released, the spring forces the striker onto the cap, igniting the fuze which explodes the detonator, setting off the pellet and causing the latter to explode the grenade. If the grenade adheres, it has a much more powerful effect inward on the target than outward. After throwing or planting, the operator has five seconds in which to obtain cover.

THE No. 75 (Hawkins) grenade (Fig. 2) is a small anti-tank mine intended to stop tanks by damaging their tracks or suspensions. It is exploded by the weight of a vehicle passing over it. It may be either thrown from cover into the path of an approaching vehicle or hidden in grass or undergrowth or buried just below the surface of the ground. Another effective method is to string together a number of these grenades about two feet apart and pull them across the path of an approaching tank. The grenade can also be used either singly or in numbers for demolition purposes. The body of the grenade is filled with high explosive. On one side are two pockets with slots cut in them which form the detonator holders. The striker plate is supported by two brackets, the striker itself being above the slots in the pockets.

The detonator unit consists of an igniter and a detonator, two of these units being required for each grenade. The igniter is a tube containing glass capsules one of which is

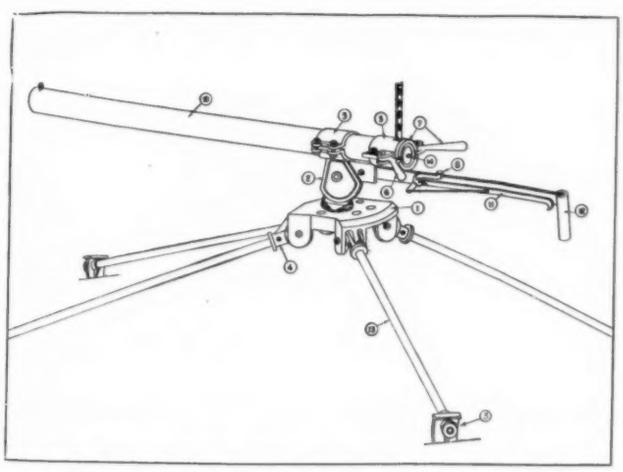


FIG. 3. THE NORTHOVER PROJECTOR

1. Base. 2. Pivot. 3. Spades. 4. Leg socket. 5. Breech ring. 6. Breech-locking lever. 7. Breechblock and handle. 8. Firing hammer. 9. Barrel clip. 10. Barrel. 11. Trigger bar. 12. Operating handle. 13. Legs. 14. Primer nipple.

filled with acid and the other with a chemical mixture. The detonator is a tube, smaller in diameter than the igniter. Its open end is inserted in the open end of the igniter, the joint being covered by a rubber tube. The detonator units are then placed in the pockets of the detonator holders and secured there with metal tabs.

The grenade is so shaped that, when thrown, it will come to rest with the striker plate either on top or underneath. It will function equally well in either position. When run over by a vehicle, the striker is forced down, crushing the igniter tubes and breaking the glass capsules. The action of the acid on the chemicals produces a flash, setting off the detonator which in turn explodes the grenade. This weapon, whether used as a grenade or as a mine, has proved most effective in the North African campaigns. It is cheap, light, safe, and easy to transport.

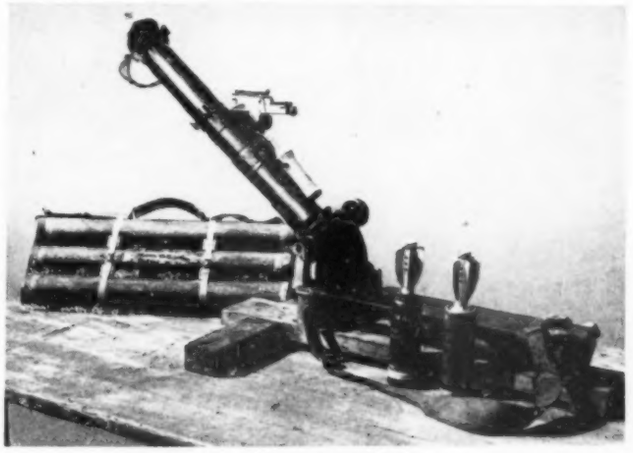


FIG. 4. THE 2-INCH MORTAR

The self-igniting phosphorus bomb (S.I.P.) consists of a glass bottle holding about a pint of liquid under a pressure of at least sixty pounds to the square inch. The liquid is in three layers: at the bottom is half a pint of sulphide of phosphorus, in the center one-half inch of water, and on top nearly half a pint of benzine mixed with toluene and a little India rubber in solution. The small space above the top layer is filled with benzine vapor. On impact, which must be severe, the bottle breaks, and the phosphorus, as it meets the air, bursts into flames. This grenade is used against tanks to set them on fire. It can be thrown by hand or fired from a Northover projector.

The hand incendiary bomb provides a quick and simple means of setting fire to stores, buildings, crops, etc. The safety cap having been removed, the percussion cap is exposed. This, struck sharply on a hard surface, ignites a length of fuze which burns for five seconds and then sets alight the inflammable contents of the bomb.

THE inclusion of the small, lightly armored Bren carrier in the equipment of Britain's infantry battalions has proved one of the wisest steps taken in the reëquipment of the infantry arm during the last few years (see illustration on p. 331). The carrier is a small, tracked, open-top vehicle weighing approximately 3¾ tons, having 10 mm. of armor plate around the front, sides, and back. It is powered by a Ford V-8 engine of 78½ horsepower in the center. This is sufficient to give the carrier a maximum road speed of thirty miles an hour, though the cruising speed is usually in the neighborhood of twenty. The vehicle is steered by brakes, with a differential for rapid turning.

The crew normally consists of three men, though a fourth may be added if the battalion strength will allow, and in

emergency a greater number can be carried. The usual armament is one Bren light automatic gun. One Boys antitank rifle is carried per section of three, and one 2-inch mortar. Grenades are also carried.

The armor is proof against rifle and machine-gun bullets, but not against armor-piercing projectiles, and, as the weight

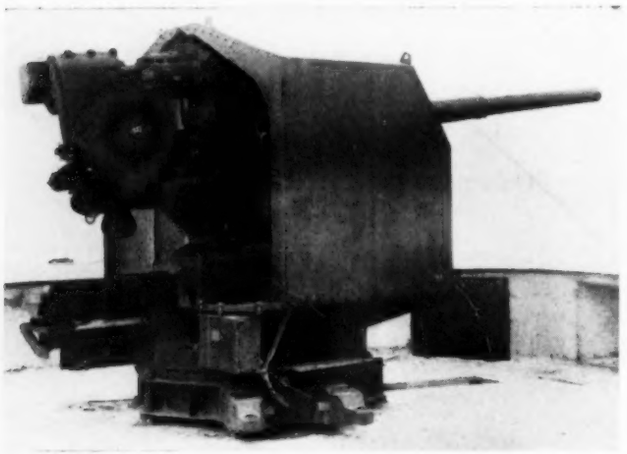


Fig. 5. The 4.5-inch Antiaircraft Gun

and general design of this little vehicle do not allow for armored overhead cover, the carrier is not meant to be used as a light tank or an armored car. This must be borne in mind by the crew, as movement under fire may tilt the open hull toward the enemy, thus exposing the personnel. Its relatively light weight classes the carrier with the rest of the infantry-battalion transport and insures that it can employ the same bridges, rafts, or improvised means of crossing water. Various methods of floating carriers across water have been tried with success.

The speed is sufficient to enable carriers to move in any part of a column of motorized troops or their transport and to carry out an efficient protective rôle across country in front of advancing infantry. The crew should be able to take one another's places if required, either to observe, map read and direct, drive and maintain the vehicle in running order, or fire the weapons.

The drivers attain considerable skill in maneuver, can pass through openings with only a narrow margin of safety, and turn around almost in their own length after coming to an abrupt halt from top speed. Acceleration is rapid; the Ford gearbox is rugged and has a very low gear for cross-country hill climbing; the engine and transmission have proved to be most reliable, and any noise which is made is due to the tracks rather than to the power unit.

The crew carry their ammunition and essential equipment with them, but space is somewhat limited. They are exposed to the wind and weather and are provided with leather jackets. The carrier is not a large target, the height being 5 feet, 2½ inches. The length is 12 feet and the width 6 feet, 9 inches. The ground clearance is 8 inches.

The tactical handling of the carrier is governed by its characteristics and limitations. As it is only partially armored, it cannot always follow close behind tanks in the attack. Being small, it cannot cross all the obstacles which can be crossed by a tank, and good ground scouting and a signal system between vehicles are always necessary. The crew are completely exposed at the moment when they dismount to come into action, and rapid drill is necessary to shorten this dangerous period. Once in action, the crew can make use of available cover, but there are too few of them to do more than serve their weapon. They cannot provide full protection by observation, though they should be able to strengthen their position by giving mutual support between one Bren machine gun and another.

In emergency, the automatic gun can be fired from the carrier, even when in movement, and cases have occurred where carriers have even charged and run over the enemy successfully, but these are exceptional. The carrier is simply an armored vehicle designed to carry a light machine gun and its crew from one ground position to another.

In an advance, either on roads or across country, the sections of carriers move by tactical bounds, carrying out short reconnaissance to front and flanks, and often taking over bounds already gained by special reconnaissance troops until their infantry come up. They are also well suited to provide a flank guard, either moving parallel to the main body of the battalion or holding a series of static positions on the flank in rapid succession. As a protection to the battalion during withdrawal, carriers may either use their speed to move behind ridges from one advantageous position to another, or may lie concealed and ambush the enemy before making a rapid withdrawal.

When an attack is partially held up, the carriers are used to bring fire quickly onto the enemy from a flank, thus helping the attacking infantry forward again. If the battalion attack is in coöperation with tanks supported by an artillery fire plan, then the carriers are usually kept in hand until the situation will allow them to infiltrate through gaps in the enemy defense and attack isolated opposition or work around flanks. But in a set attack they can also greatly assist infantry tanks, as they can sometimes move closer behind them than the infantry on foot and are able to engage enemy antitank guns from under the cover of the tanks.

On consolidation or in defense on outpost, carriers are able to hold a wide front and to withdraw into mobile reserve as soon as they can be relieved by the infantry of the battalion. They are less suitable for use at night than by day, because the strength of the carrier platoon is in its ability to develop a large amount of automatic fire quickly over a large area, its weakness being that it has not the man power to defend itself at close range, as in night fighting.

THE 3.7-inch gun is the standard heavy antiaircraft weapon of the British Army both in the field and in fixed defenses. It rendered immense service in the Battle of Britain, and it accompanies the army everywhere—Malta, North Africa, India—where there are vital areas and concentrations of troops or materials to protect, whether behind the line or forward. The punch of this fine weapon, which can send a 28-pound shell up to 40,000 feet, has not only been demonstrated most effectively in the air, but, in emergencies, has played havoc with the heaviest armor of the German Afrika Korps on the ground.

The field mounting is drawn by a tractor to which it is connected by a limber. It travels on four wheels, two belonging to the limber and two to the carriage. To bring the gun into action, the platform is raised on jacks, disconnected from the axeltrees, and lowered to the ground. The limber wheels are removed to the rear and the carriage wheels are raised on derricks in which position they help to hold the mounting down on firing (Fig. 6).

At the same time, four legs or outriggers are thrown out

radially, one from each corner, so as to form extension supports for the platform, and are secured each by a steel picket. The platform is then carefully cross-leveled. In the case of the fixed mounting, the platform is attached to a holdfast buried in concrete. The superstructure of the mounting is pivoted in the basic structure, to which it is clipped. It can be traversed on live rollers through 360 degrees and can be given an elevation of 80 degrees.

The barrel can be removed from the breech ring and changed on the spot, though the operation takes some hours. The breechblock is of the horizontal sliding type. It is semi-automatic in action and, on recoil, opens, ejects the fired case, and recocks the striker. It is held open by catches until the next round is rammed home, which operation releases the catches and allows it to close automatically under the pressure of a spring.

Loading may be carried out from a rocking tray, but a higher rate of fire is obtained by ramming the 50-pound round (shell and propellant) directly into the breech by hand. The shock of firing is taken up by an oil buffer and a compressed-air recuperator, the latter returning the gun to the firing position. The rate of fire is twelve rounds a minute.

The guns, each with a detachment of nine men, are normally emplaced around a command post in groups of four. In the site is a height finder with a crew of three, which measures the height and range of the target in its present position and passes them to a predictor.

The projectile employed at heights of 5,000 feet and upward is high-explosive shell with either a powder-filled or mechanical fuze. Open sights and shrapnel are used against low-flying and dive-bombing aircraft, and open sights and armor-piercing shot against tanks.

Our aim in training is to insure quick spotting of enemy aircraft, accuracy in the instruments, and steady drill. As guns fired singly do not produce the maximum weight of fire in the target area, we stress that on the command "Fire!" the four muzzles shall speak as one. Targets are of course engaged outside the area of probable bomb release and, as far as possible, during the period of the airman's run-up.

How great an advance the 3.7-inch gun is on the 3-inch—its predecessor in the rôle of our principal heavy antiaircraft gun—may be gauged from the fact that, compared with the latter, its chances of destroying an enemy aircraft at any given height are as 2½ to 1. It is in the same category as the German 88-mm. gun but has 4,000 more yards of range than that weapon and a shell heavier by 6 pounds. It is, in short, a weapon that has contributed its full share to British confidence and strength.

IN Britain, the 4.5-inch antiaircraft gun shared with the 3.7-inch the task of blunting the night attacks delivered by the *Luftwaffe* against ports, centers of industry, and the population during the autumn and winter of 1940-1941. These two weapons did not fail. Under the air umbrella they provided, factories and docks continued to function in spite of the devastation spread around them.

One battery protecting a famous British port wore out its barrels every night for a week and, so as to be ready for further raids, the short winter day was spent in changing them—a process that takes several hours and requires the use of a crane. The attacks spent themselves without ever putting the port out of action.

The 4.5 (Fig. 5) is in the main a large edition of the 3.7 described above and need not be explained in detail. It will be remembered that the 3.7 can be fired either from a traveling platform lowered to the ground or from a platform secured to a permanent holdfast. With the 4.5, owing to its greater weight and power, only the latter method is used. It is not a mobile gun, but it can be moved on wheels from one holdfast to another if the situation makes it necessary.

FIG. 6. THE 3.7-INCH ANTIAIRCRAFT GUN

The holdfast, which was not described in the case of the 3.7, consists of upper and lower frames, each 7 feet, 2 inches square, joined together at the angles by bolts 4 feet, 3 inches long. After assembly it is buried in concrete, the upper ends of the bolts alone protruding. Immediately above the holdfast is the "bed" which serves to attach the mounting to the holdfast and, through extensions to front and rear, to form a support for the mounting when placed on wheels. It consists of a box-shaped frame and is held to the holdfast by bolts. A lower "racer ring" is secured to the upper side of the bed by bolts which pass through holes in a circumferential flange formed at its base. This acts as a race for the rollers on which the superstructure revolves.

To counteract muzzle preponderance due to the trunnions being displaced to the rear, a counterweight, consisting of 2,000 pounds of lead, is attached by two supporting arms to the rear of the cradle. An overhead shield is provided for the protection of the personnel and fittings against blast and small splinters.

The gun weighs 2¾ tons; gun and mounting, 16½ tons. It has all-around traverse and a maximum elevation of 80 degrees. A complete round of ammunition weighs 86 pounds; the projectile, whether high explosive or shrapnel, 54½ pounds. The rate of fire is about 8 rounds a minute.

These are some of the weapons which helped to win the Battle of Britain and to drive the Germans from North Africa. They will be heard from again and again as the United Nations sweep on to further victories.

EDITOR'S NOTE.—Writing on "Artillery Today" in the January-February 1943 issue of ARMY ORDNANCE (Vol. XXIV, No. 136, p. 73), General Rowan-Robinson made the following statement:

"In Britain's desert warfare in Libya, she has found 25-pounders of such outstanding value that she builds small mobile columns around a section, troop, or battery of them. They are the main weapons to tackle the heavier German tanks at longer ranges. They have, therefore, become the principal instruments both of offense and defense . . ."

The Army's 2½-ton Amphibious Truck

A big brother of the amphibious Jeep, the Army's new 2½-ton "Duck," shown above, can transport supplies from ship to shore at 8 to 10 miles an hour, disengage its propeller, and then travel overland as a 6-wheel-drive truck to be unloaded close to the supply dump, as shown below. The vehicle can carry 31 men on land and 50 on the water (Signal Corps photos)

Recent Developments in Army Matériel

The powerful 57-mm. antitank gun, above, an American version of the British 6-pounder, is now replacing the hard-hitting 37-mm. weapon in Infantry units. Below is the new mobile M1 smoke generator developed by the Chemical Warfare Service. It will produce dense smoke to conceal troops or protect installations against enemy attack (Acme photo).

Ordnance with the Air Forces

Servicing Guns, Bombs, and Ammunition for Our Fighting Fliers

Col. Harold J. Conway

IT was said comparatively recently that "An airplane without bombs, guns, and ammunition can give an enemy nothing but a dirty look." The statement made quite a hit in the newspapers and over the radio waves, but it was actually five or more years behind. The Ordnance officers in Hawaii, the present Maj. Gen. Gerald C. Brant—then head of the Hawaiian Air Wing—and the Ordnance Department had been thinking of this for years.

As Ordnance officers, particularly concerned with the supply and maintenance system as applicable to what we today call the Army Air Forces, they were literally dismayed when observation at that time showed that it took sixteen hours to fill the racks of nine small bombers. There was no thought of the necessity of dispersal of the aircraft, blackout conditions did not exist, and the danger of enemy aircraft interrupting the work was years away. The job was carried on under almost perfect conditions, and yet the organization and development of bomb-handling equipment was so disorganized that the task took this unreasonable amount of time. Today, a similar job would not take much longer than thirty minutes, and the equation has changed from 100-, 200-, and possibly 500-pound bombs to those weighing up to 4,000 pounds.

The result of these observations gave birth to the idea that an additional specialty must be added to the long list of responsibilities of the Ordnance Department; namely, officers, men, and an organization that could quickly and efficiently service the guns on the airplane and keep its ammunition and bomb racks filled. About this time, the campaigns in China and Europe were teaching us lessons unparalleled in history, and varied opinions finally were crystallized into a definite recommendation by one of the Air Corps' most capable officers, the late Maj. Gen. F. M. Andrews. In his final report as Commanding General, General Headquarters Air Force, and just previous to becoming Assistant Chief of Staff G-3 of the War Department General Staff, he said:

"The G.H.Q. Air Force is a mobile military organization which must be self-contained for supply, transportation, and maintenance and in accordance with the 1937 annual report of the Secretary of War 'Be ready for combat almost immediately on the opening of hostilities.' For any given theater of operations the degree of readiness for such early entrance into combat will be measured by a previously provided number of air-base installations for shelter, water, landing and take-off, communications, supply, and maintenance. For this reason permanent air bases in strategic locations should exist in time of peace.

"The entire concept of the air base and its service troops is (1) to enhance the mobility of the combat units by relieving them of as many administrative, technical, and supply functions as have been found practical; (2) to make the impetus of supply truly from rear to front; (3) to conserve man power and organization equipment by pooling services, machinery, and transportation; and (4) to permit operating service elements along functional lines, while preserving their mobility."

Then, and what was more pertinent to Aviation Ordnance and really defined its place in the picture, General Andrews said:

"The required service organizations of the supply arms and services other than the Air Corps *are just as much a part of the G.H.Q. Air Force* [italics supplied] as are the Air Corps organizations themselves, and all service organizations must be mobile, equipped for field service, and available to the G.H.Q. Air Force commander for movement when required."

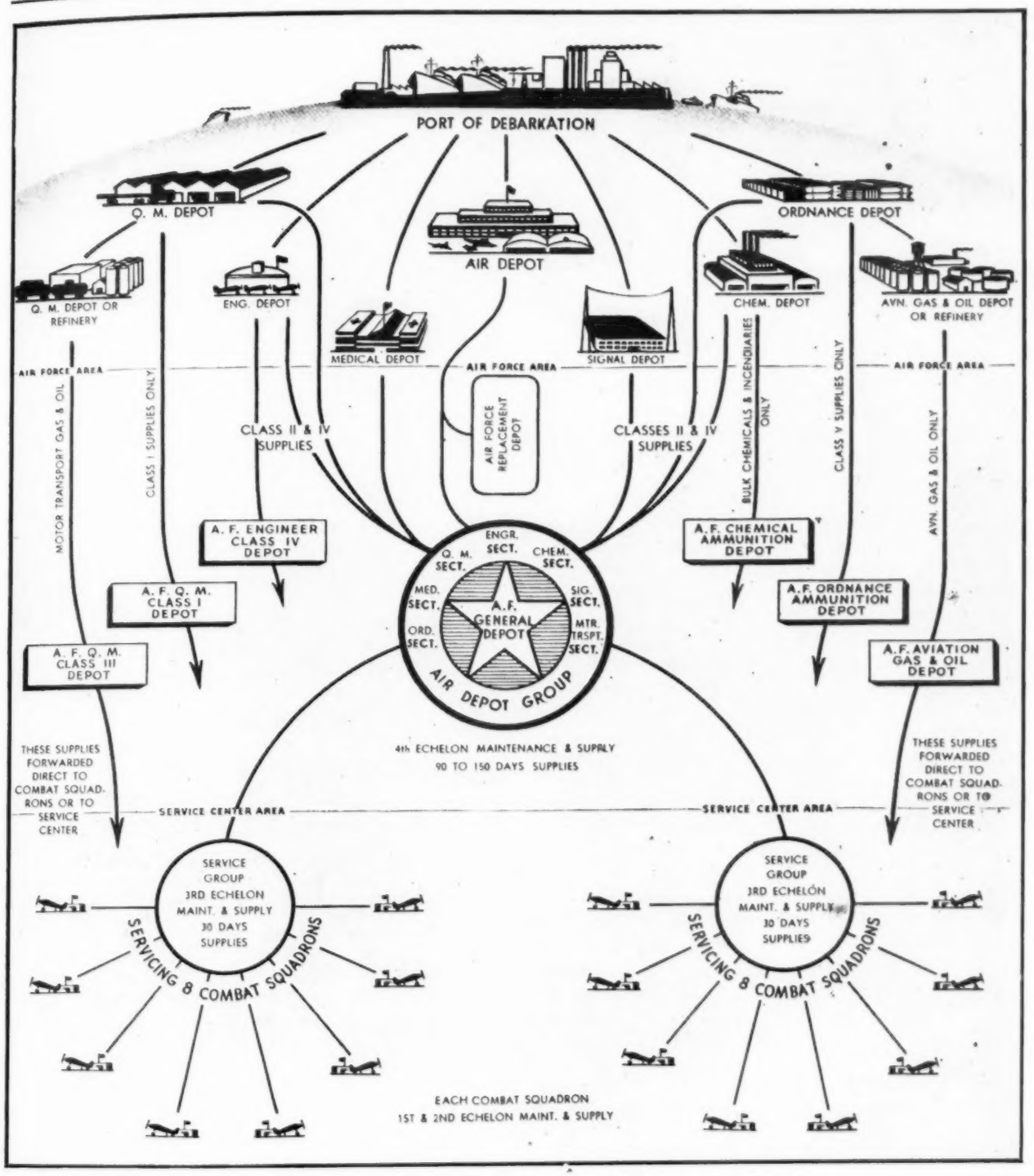
As to the organization to carry out this mission, General Andrews stated:

"The service elements recommended consist of G.H.Q. Air Force air-base units as follows: Base headquarters; Air Corps base troops with attached finance, engineers, and chaplain personnel; Transport group, G.H.Q. Air Force; Medical detachments, air base; *Ordnance battalion, G.H.Q. Air Force* [italics supplied]; Signal battalion, G.H.Q. Air Force; Quartermaster regiment (truck); Separate Quartermaster companies, air base; Chemical battalion, G.H.Q. Air Force."

THE result was the establishment of the Aviation Ordnance section of the still small peacetime Ordnance School at Aberdeen Proving Ground, Md. The course was six months long—three months at Aberdeen and three months of actual work on various types of airplanes at Langley Field, Va. The school was new, and there were plenty of headaches, but the first class of eleven students struggled along. It may be safely said today that these pioneers have paid dividends that can be measured only by our successes in all theaters of this global war. With a director, who had had extensive Ordnance and Air Corps experience, and two assistants carrying the burden, as soon as the first class graduated from their fundamental period and proceeded to Langley Field, a new class of sixteen students was organized. Among these sixteen was one officer from the U. S. Marine Corps. It may be well to recall at this time that no noncommissioned officers or enlisted men had been given any formal training in aviation ordnance.

Then came the outbreak of the present war in Europe and shortly thereafter the declaration of Limited National Emergency with the building up of our armed forces, selective service, and the "defense" period. Regular officers and hundreds of Reserve officers poured into the Ordnance School, and the Aviation Ordnance Section received its quotas. A few noncommissioned officers and enlisted men were enrolled into the courses for the forming of cadres and additional instructors. The Ordnance Training Center, with its three echelons—the Ordnance School, the Ordnance Replacement Training Center, and the Unit Training Center—came into being. Officers and men were trained for all types of Ordnance service from the supply of ammunition to the

Colonel Conway is chief of the Executive Branch, Ordnance Field Service Division. He was formerly deputy chief of the Ordnance Military Training Division and was the first director of the Aviation Ordnance course at the Ordnance School, Aberdeen Proving Ground, Md.


PORT OF DEBARKATION
Q. M. DEPOT
AIR DEPOT
ORDNANCE DEPOT
Q. M. DEPOT OR REFINERY
ENG. DEPOT
MEDICAL DEPOT
SIGNAL DEPOT
CHEM. DEPOT
AVN. GAS & OIL DEPOT OR REFINERY
AIR FORCE AREA
AIR FORCE AREA
AIR FORCE AREA
MOTOR TRANSPORT GAS & OIL
CLASS I SUPPLIES ONLY
CLASS II & IV SUPPLIES
AIR FORCE REPLACEMENT DEPOT
CLASSES II & IV SUPPLIES
BULK CHEMICALS & INCENDIARIES ONLY
CLASS V SUPPLIES ONLY
AVN. GAS & OIL ONLY
A. F. ENGINEER CLASS IV DEPOT
A. F. CHEMICAL AMMUNITION DEPOT
A. F. Q. M. CLASS I DEPOT
A. F. ORDNANCE AMMUNITION DEPOT
A. F. Q. M. CLASS III DEPOT
A. F. AVIATION GAS & OIL DEPOT
ENGR. SECT.
Q. M. SECT.
CHEM. SECT.
MED. SECT.
SIG. SECT.
A. F. GENERAL DEPOT
ORD. SECT.
MTR. TRSPT. SECT.
AIR DEPOT GROUP
4th ECHELON MAINTENANCE & SUPPLY
90 TO 150 DAYS SUPPLIES
THESE SUPPLIES FORWARDED DIRECT TO COMBAT SQUADRONS OR TO SERVICE CENTER
SERVICE CENTER AREA
SERVICE CENTER AREA
THESE SUPPLIES FORWARDED DIRECT TO COMBAT SQUADRONS OR TO SERVICE CENTER
SERVICE GROUP 3RD ECHELON MAINT. & SUPPLY 30 DAYS SUPPLIES
SERVICING 8 COMBAT SQUADRONS
SERVICE GROUP 3RD ECHELON MAINT. & SUPPLY 30 DAYS SUPPLIES
SERVICING 8 COMBAT SQUADRONS
EACH COMBAT SQUADRON
1ST & 2ND ECHELON MAINT. & SUPPLY

THE ORGANIZATION OF AIR FORCES SUPPLY IN THE THEATER OF OPERATIONS

maintenance of artillery and fire-control instruments. Aviation Ordnance received its appropriate share of trainees.

As air bases were activated, fully trained units were ready to do their part. Aviation Ordnance officers were ready to advise and supply the flying personnel in so far as armament was concerned. Flying crews no longer had to devote themselves to anything but their primary mission—flying. They knew the supply and maintenance problem was well taken care of by the skilled Ordnance units. Long hours of training were beginning to pay dividends. Those with "butterfingers" had been weeded out. Those remaining had worked with live bombs filled with TNT or amatol, with fuzes armed with fulminate of mercury. They knew their business, and there was nothing but praise from those whom the Aviation Ordnance battalions and companies served—the officers and men of the Air Forces.

ON July 1, 1942, the entire picture of Aviation Ordnance was drastically altered. The Aviation Ordnance companies (bombardment and pursuit) were eliminated, and, in their stead, an Ordnance section was made a part of each tactical squadron. The immediate effect of this move was to increase the work required of Ordnance personnel. Previously, an Ordnance platoon of 41 men had served a heavy bombard-

ment squadron of 8 planes, and now an Ordnance section of 29 men was called upon to perform the same service for a squadron increased to 12 planes.

It cannot be denied that a certain *esprit de corps,* a feeling of oneness with the group, was lost when the old Ordnance companies were inactivated and the personnel scattered to the various squadron sections. However, it may be equally argued that the change resulted in a closer fusion between a vital combat arm and an equally essential service. An Air Force which had already received its baptism of fire knew that guns and cannon, bombs and bullets, were as important as speed and maneuverability of airplanes in winning battles. Ordnance suddenly loomed as a significant word on the horizon, and the young lieutenant in the squadron Ordnance section emerged as a vital person at the council table. Charged with the responsibility for rendering technical advice to the squadron commander, he came to be consulted on almost any subject, however remotely allied to Ordnance. In faraway places of combat, the ingenuity of Aviation Ordnance men was put to the acid test. How well they succeeded may not be fully realized until the deeds of this conflict pass into the annals of history.

In a Southwest Pacific area, for example, an Ordnance officer was asked to furnish the commanding officer with an armored car. The car was designed and built out of any and all scrap material salvagable. While it probably failed to revolutionize the tactics of mobile warfare, it nevertheless demonstrated the resourcefulness of the trained Ordnance soldier. Another time, this same officer was called upon to deactivate a floating mine which had lodged in the harbor, causing no little concern among those who came and went that way. It was not necessarily his job—but he was Ordnance and was expected to know those things.

ONE of the functions of the squadron Ordnance section is the delivery of bombs and ammunition to the plane. The old line of demarcation between Air Corps personnel and Ordnance is often disregarded because of the exigency of the situation when it comes to loading the bombs in the plane. Very often Aviation Ordnance men go beyond their prescribed duties and not only load bombs into the plane but actually take care of the maintenance of such equipment as racks and turrets.

With regard to delivery of ammunition, lack of prescribed equipment often calls for demonstration of initiative. Interesting reports from an officer in the Middle East theater of operations reveal that cargo trucks and native man power were often pressed into service in lieu of the prescribed bomb trucks and trailers. Utilizing this "Wog power," as employment of native labor is called, he attained the desired results in a sometimes crude but effective fashion.

On the heels of the elimination of the bombardment and pursuit companies came the assumption of the maintenance of all wheeled vehicles by Ordnance. The Aviation Ordnance officer awakened to find himself in command of an Ordnance Company, Aviation (Medium Maintenance, Quartermaster), and with the headache of motor maintenance. This phase of Ordnance has become one of the most important of its many functions in recent months. The term "deadline vehicles" became a challenge to the officer who had previously concerned himself with guns and ammunition only.

In February 1943, the old Ordnance Company, Aviation, Air Base, gave way to the Ordnance Supply and Maintenance Company, Aviation, which was organized to include the essential personnel of the former company and the aforementioned Ordnance Company, Aviation (Medium Maintenance, Quartermaster).

Meanwhile, the installation in the combat area corresponding to an air base in continental United States had become known as a "service center," and a service group was organized to take care of the needs of the two combat groups that might be stationed there. This is where the Ordnance Supply and Maintenance Company, Aviation, fits into the picture. Two such companies were provided for each normal-size service center to perform the necessary third-echelon Ordnance maintenance and supply there. An Ordnance section in the headquarters of the service group was set up to supervise the activities of all Ordnance units providing service at that installation.

New and interesting problems came thick and fast for the young officers in charge of the Ordnance groups—and most of them were young in point of experience because Aviation Ordnance itself is relatively new. Flight personnel of the Air Corps became vitally interested in the performances of their weapons, the ballistics of projectiles fired from aircraft, and the selection of specific bombs and fuzes for designated targets. To the Ordnance officer they came seeking the answers, and his job never lacked variety.

FOR every two service centers, an air depot was established for the maintenance of airplanes and the supply of Air Corps matériel. Aviation Ordnance was not forgotten here, and we find an Ordnance section in the headquarters squadron of the air-depot group maintaining the weapons on those planes which come into the depot for repairs. Still further back, an air-force general depot was set up as a supply and fourth-echelon maintenance installation for all air-force units serving within that particular area. Ordnance is here represented by the Ordnance Depot Company, Aviation, and the Ordnance Maintenance Company, Air Force. The Ordnance Ammunition Company, Aviation, operates at the air-force ammunition depot. In addition to all the Ordnance units described herein, there is, of course, an Ordnance section in the headquarters of each wing, command, and air force. These are special staff sections which provide the commander of the unit concerned with technical information.

The Aviation Ordnance man has not gone unhonored for his work in this war nor has his job kept him secure in "safety zones" where service troops are erroneously supposed to remain. The ill-fated bombardment company which served with the famous 19th Bombardment Group in those memorable days of the war's beginning was cited for its devotion and sacrifice to duty in the Philippines. More recently, special commendation was given to the Aviation Ordnance personnel without whose valuable aid the triumph of the Bismarck Sea episode would not have become history. Aviation Ordnance men were there in the first landings at Casablanca. The first graduate of the original Ordnance Officer Candidate School at Aberdeen to be killed in action was an Aviation Ordnance officer.

In the development of air-combat techniques that have been perfected in this war, including dive bombing, skip bombing, bombing with incendiaries, and many others, there will be found, undoubtedly in the background but there nevertheless, Ordnance men whose research, ingenuity, and tireless devotion to duty have helped make our fighting Air Forces so effective against the enemy on every front.

Aërial Firepower

As the U. S. Army Air Forces celebrates its thirty-sixth anniversary, it is appropriate to note the vast strides that have been made in the development of military airplanes and aircraft armament. On August 1, 1907, the Division of Aëronautics was established in the Army Signal Corps "to study the flying machine and the possibility of adapting it to military purposes," and one captain and two enlisted men were assigned to the air division. On August 2, 1909, the first military "flying machine" was purchased by the Army from the Wright brothers after it had flown for an hour and twelve minutes at an average speed of nearly forty-eight miles an hour! When America went to war on April 6, 1917, Army aviation consisted of 65 officers (only 35 of whom were fliers), 1,087 enlisted men, and 55 airplanes—not one of which mounted a machine gun.

Today, nearly 2,000,000 men—expertly trained pilots, bombardiers, radio operators, navigators, technicians, and gunners—and more than 100,000 of the world's finest airplanes comprise the Army Air Forces. The combat ships of this air armada have speeds of up to 400-odd miles an hour, are heavily armored, and mount numerous machine guns and automatic cannon firing high-explosive projectiles. And, as Gen. H. H. Arnold, Commanding General of the Air Forces, predicts in his article on page 317 of this issue, larger bombers and heavier armament are in prospect.

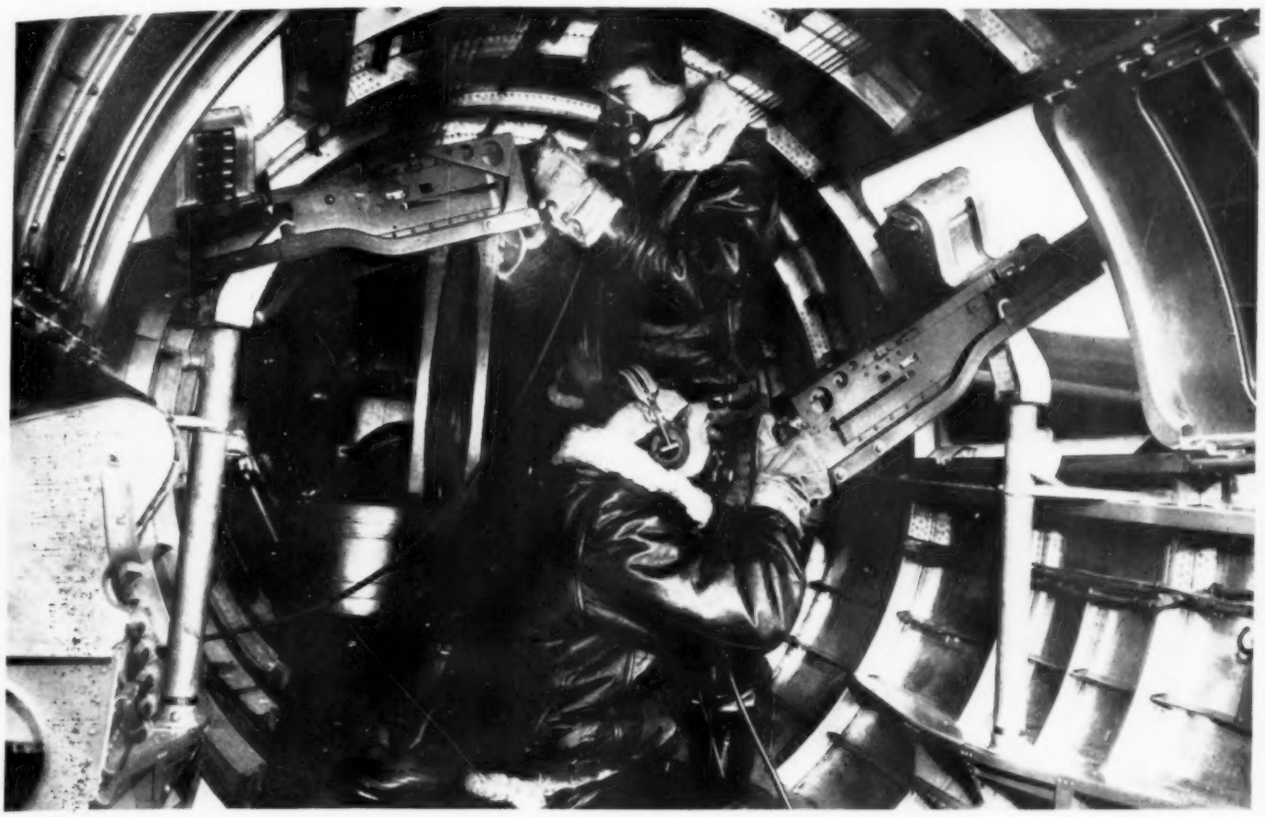
The first weapon to be fired from a military airplane was a rifle carried aloft in 1910. A machine gun was flown in a plane for the first time in 1912, but such guns were not standard equipment since the rôle of the airplane seemed to be unarmed scouting and observing. Today, our combat aircraft literally bristle with machine guns and cannon, as shown in the accompanying illustrations, and the record of enemy planes shot down in air battles is of impressive proportions. Chief among our aircraft weapons for firepower and flexibility is the caliber .50 machine gun which is mounted on bombers and pursuit ships alike.

It is the job of the Ordnance Department of the Army to keep the guns of the Air Forces planes in fighting trim and to supply the necessary ammunition, bombs, and accessories. To this end, Aviation Ordnance personnel have been assigned to every unit of the Air Forces, from the tactical squadron up to the general depot, as well as to the headquarters of each wing, command, and air force. Aviation Ordnance responsibility stops with the delivery of the bombs and ammunition to the airplane, but in the combat areas such distinctions are often disregarded by Ordnance men who pitch in to help load the bombs and ammunition into the plane and to repair and maintain such equipment as bomb racks and gun turrets. "Teamwork" is the keynote, and the goal is to get the ship into the air and over the enemy in the shortest possible time. It is this Ordnance-Air Forces teamwork that is helping drive the enemy from the skies with superior flying and deadlier firepower. (Most of the accompanying illustrations are from Air Forces photographs.)

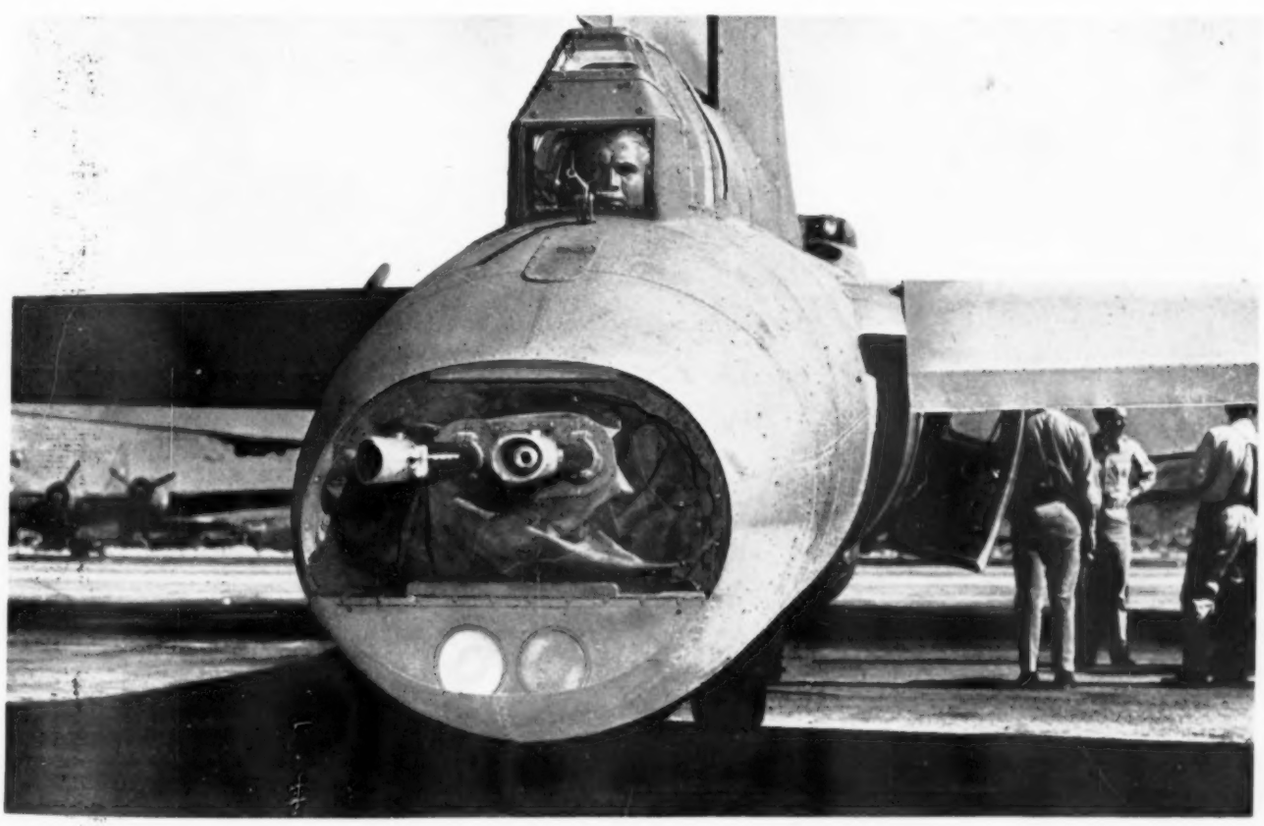
The Firepower of the Flying Fortress

The three machine guns mounted in the nose of the Boeing B-17F Flying Fortress bomber above (O.W.I. photo) effectively discourage frontal attacks. The revolving power-operated ball turret, below, equipped with two caliber .50 machine guns and a computing sight, protects the underside of the Fortress. The top turret is shown in the photo on page 341.

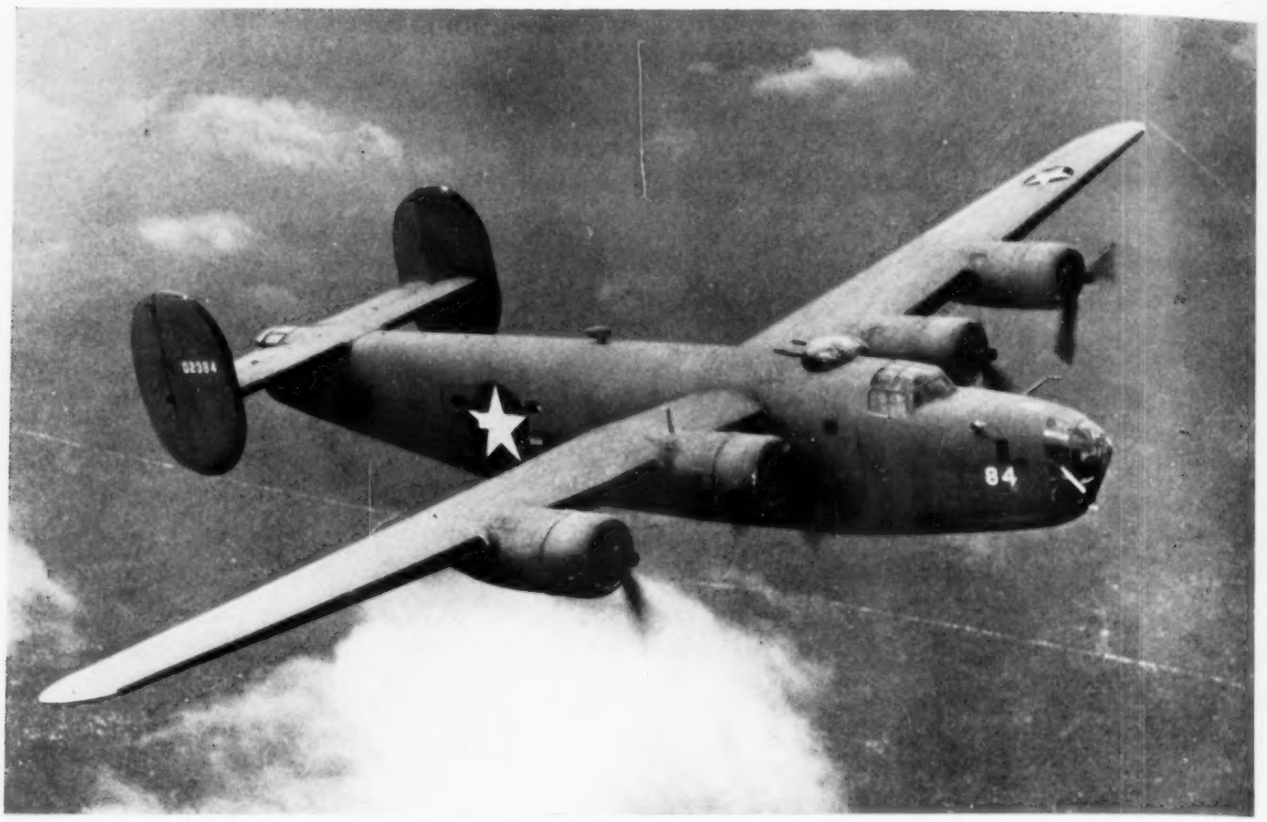
Guns Protect the Fortress from Every Angle



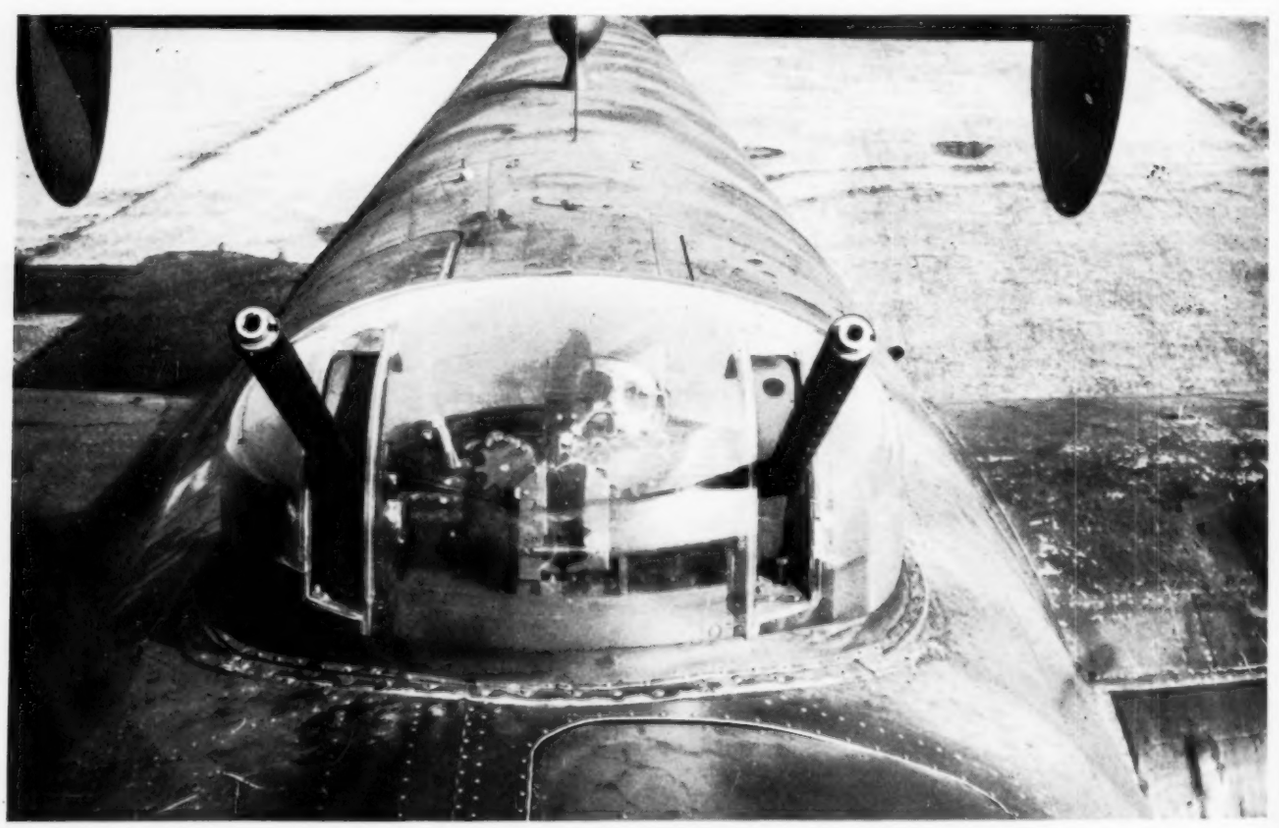
The caliber .50 waist guns, above, guard each side of the Fortress. Crew members must wear heavy clothing and oxygen masks when fighting near the ship's ceiling of about 36,000 feet. The tail "stinger," below, which was missing from the first Fortresses, consists of two caliber .50 machine guns—part of the plane's armament of thirteen or more weapons.



The Consolidated B-24 Liberator Bomber

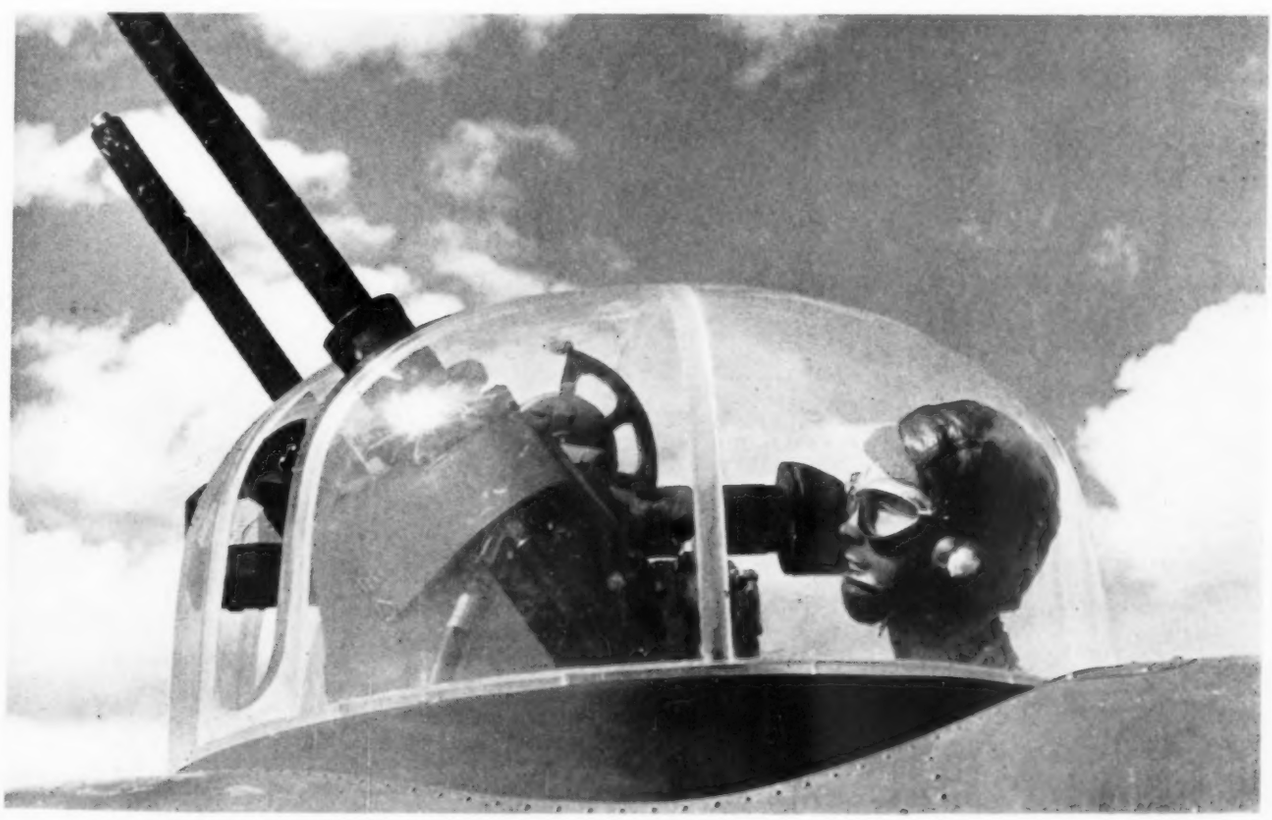


The Consolidated B-24 Liberator heavy bomber, shown above, is armed with about ten caliber .50 machine guns, two of which are mounted in the power-operated top turret as shown below. The Liberator is slightly faster than the Flying Fortress and has a somewhat longer range. With a top speed of over 300 m.p.h., the B-24 can carry about 4 tons of bombs.



The North American B-25 Mitchell Bomber

The North American B-25 Mitchell medium bomber, above, carries two caliber .50 machine guns in a top power turret (shown below) as well as guns in the nose and tail. The airplane also mounts several fixed forward-firing machine guns. The B-25 is powered by 2 double-row 1,700-horsepower engines which give it a cruising speed of about 220 m.p.h.



The Lockheed P-38 Lightning Interceptor

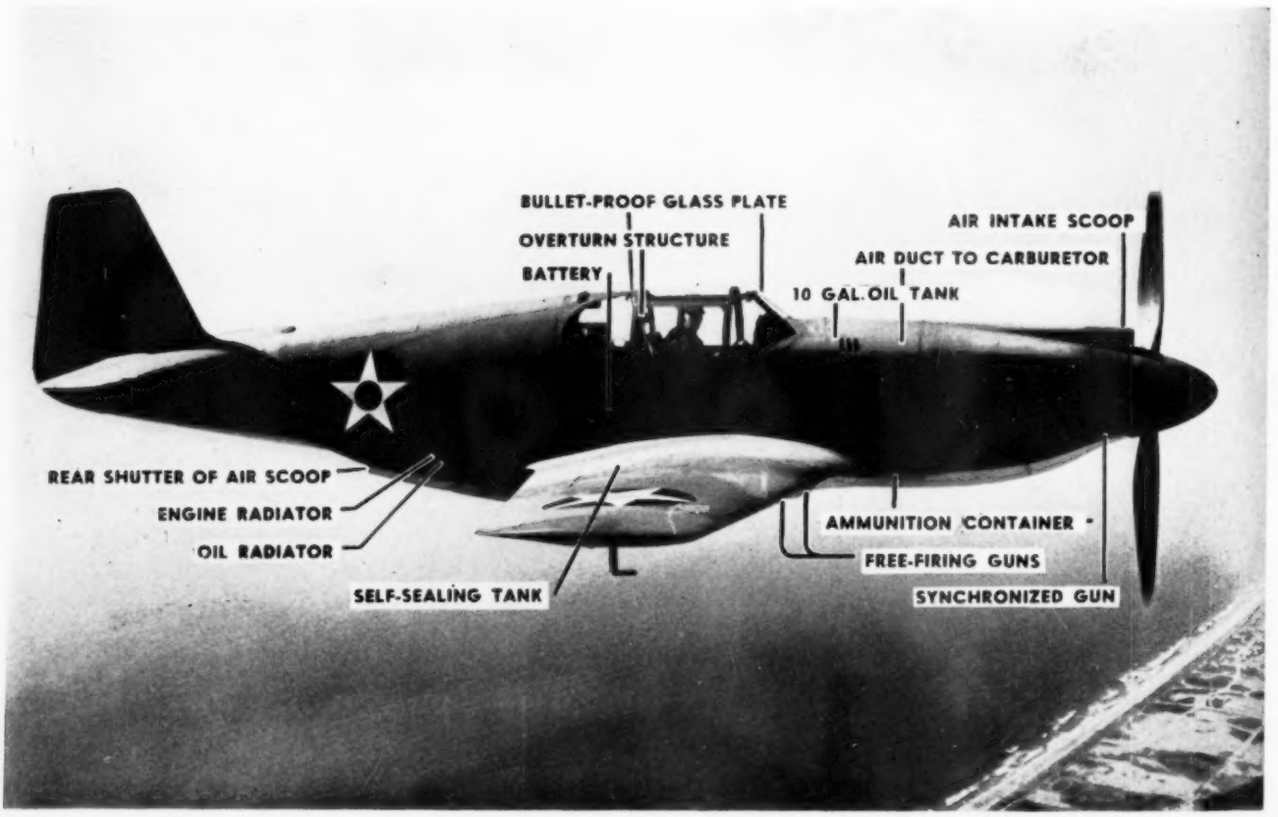
The Lockheed P-38 Lightning, above, was designed as a long-range, high-altitude interceptor, but it has also been employed as a light bomber. Its firepower from four caliber .50 machine guns and a 37-mm. cannon mounted in the nose, as shown below, also has been used to strafe ground objectives. The P-38 is well armor plated and has self-sealing gas tanks.

The Bell P-39 Airacobra Pursuit Plane

The Bell P-39 Airacobra mounts either a 20-mm. or a 37-mm. cannon in the nose through the hollow propeller shaft and has two caliber .50 machine guns atop the nose and two guns in each wing, either caliber .30 or .50—as shown in the illustrations on this page. The plane has tricycle landing gear, and an Allison V-type engine mounted behind the pilot.

The Republic P-47 and North American P-51 Pursuit Planes

The Republic P-47 Thunderbolt, shown above, has a speed of over 400 miles an hour and can operate at 40,000 feet. It is heavily armored and carries four caliber .50 machine guns in each wing. The North American P-51 Mustang, below, can mount eight caliber .50 machine guns, four cannon and two machine guns, or other combinations as may be required.



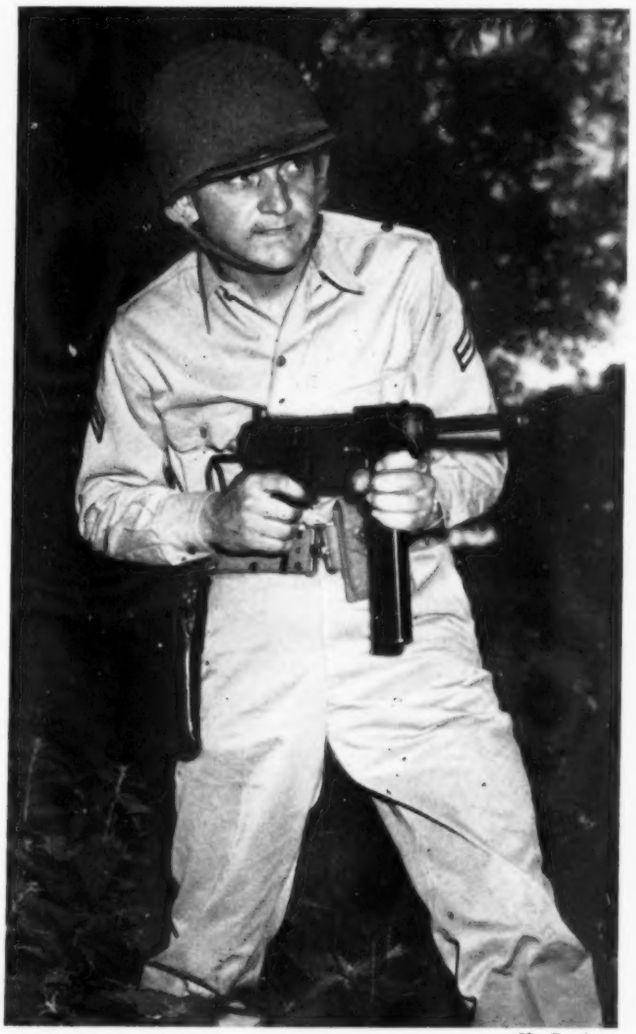
The New Submachine Gun, M3

It Is Now the Standard Submachine Weapon of the U. S. Army

Col. René R. Studler

A DESCRIPTION of the M3 submachine gun and its development would not be complete without some mention of the method by means of which it was brought into existence. Effectively, the result was obtained by a system of planned experiment, which had as its objective the solution of a specific problem in a minimum of time. As a war goes on, experience indicates new requirements which are necessary to meet new developments, either tactical or technical, on the part of the enemy or to provide means to implement a novel attack by our own forces. One of the most important functions of the Ordnance Department is to anticipate the Army's needs in such emergencies.

The emergency may appear as a result of a tactical situation on the battlefield or as a crisis caused by sudden diversion of machines and raw material to increase production of an already standard item. During the war, these emergencies arise with increasing frequency and must be met in order that the troops in the field may be provided with the weapons they require. By taking advantage of the experience gained in its own activities as well as that made available through its continued contact with industry in the United States, the Ordnance Department has improved the technique of development to meet the needs of the moment depending upon whether the nation is at peace, in a transition period, or at war.



U. S. Army

THE NEW SUBMACHINE GUN IS IDEAL FOR WARFARE IN THE JUNGLE

In our recent history, one outstanding small-arms weapon has been produced in each such period. The characteristics of each weapon and the manner in which the final design was arrived at reflect with surprising accuracy the dominant motif of the period.

The M1, or Garand rifle, as it is commonly known, is exclusively a peacetime product. Original work on this gun began in the late 'twenties, and final adoption did not take place until 1936. In the comparative leisure of the 'twenties and 'thirties, careful attention could be given to every aspect of the problem of a semiautomatic rifle. By carrying out the work in a Government arsenal, under the direction of one man, the Ordnance Department was able to maintain at all times close supervision of each stage of the development, thereby insuring satisfactory results with a minimum expenditure of money. As time was plentiful, new models could be made to test each modification proposed. Manufacturing considerations were of secondary importance when compared with ease of operation and reliability of functioning. Interest on the part of large commercial manufacturing concerns was practically nonexistent. Developed under these conditions, the M1 rifle emerged as a sturdy, reliable weapon with a minimum number of parts which simplified the problems of care by the soldier and maintenance by the Ordnance Department.

When the military requirements for a carbine were set up in May 1941, the country was in the midst of the transition from peace to war. Some time between June 1940 and December 1941, "M-day" came and passed without official recognition. During this period the prevailing mood was one of uncertainty. Commercial manufacturers were beginning to look toward the expanding arms program with considerable interest, and those with foresight were attempting reorganization of some of their facilities in order to be able to do their share of the work in the rearmament of our fighting forces.

Government arsenals were not staffed or equipped for additional major development with high-urgency requirement. Even had it been possible to obtain the machine tools and skilled help necessary, the arsenals were not large enough to meet expected demands, and manufacturing facilities outside Government plants were necessary when development was complete. Time was an important factor, yet large expenditures for development work which might not produce results were closely questioned. Under these circumstances,

Colonel Studler is chief of the Small Arms Development Branch, Technical Division, Office of the Chief of Ordnance.

U. S. Army

THE M3 SUBMACHINE GUN WEIGHS LESS THAN 9 POUNDS AND FIRES AT A RATE OF 450 ROUNDS A MINUTE

a free-for-all competition seemed to offer the most promise. By encouraging a number of commercial organizations to enter weapons in the contest, a maximum amount of talent was focused on the problem. By allowing each entrant to retain full patent rights, the prospective reward to the winner was very considerable.

The competition method, while it did produce a satisfactory weapon in the required time, had several drawbacks. In the first place, the money and man-hours spent by all entrants but one were largely wasted. Secondly, by setting itself up as an impartial judge, the Ordnance Department had to forego the right of suggesting to any contestant improvements which might result in a more satisfactory weapon. Finally, by advertising publicly all the desired characteristics, all opportunity of producing a weapon of surprise was lost.

WITH the nation at war, in order to meet the increasing demand for new items and for still greater speed in perfecting them, it became necessary to devise another method of solving the development problem. At best the task is not easy, involving as it does not only the exercise of judgment as to the basic principles of design to be employed and their application, but also considerations as to materials required and production facilities available.

Upon determination to initiate or continue the development of a new item, the Ordnance Department, with the aid of industry, immediately takes steps to negotiate and execute a development contract. Such a contract is actually a plan of experiment in which the designer, the producer, and the user combine to form a team in which each plays his part in a thoroughly well coördinated effort with a definite objective in view. The objective is defined by military characteristics prepared in the light of war experience, and progress is guided by consideration of data on items of similar type from domestic, allied, and enemy sources.

The development contract provides for the design, development, and engineering of a new item under the direction of and in coöperation with the representatives of the Ordnance Department. The Ordnance Department furnishes all assistance possible in the form of engineering and technical advice, and also frequently supplies standard items of Ordnance equipment for use in the development work on the new item. In addition, the contract usually provides for the manufacture and delivery to the Government of one or more pilot models of the new device, of complete drawings, and of notes on matériel (or instructions) relative thereto. As far as possible, every effort is made to avoid the acquisition of any new facilities for the development work. The contract, because of the necessity for security in the development work, makes provision for adequate plant protection and other necessary measures.

The agreement provides for a royalty-free license to the Government for all purposes of any inventions or discoveries made or reduced to practice in the performance of the work under the contract. In so far as other discoveries or inventions are concerned, which were made and actually reduced to practice before the execution of the development contract, the contract usually makes provision for the later acquisition by the Government, if this is found to be desirable, of the right to use such inventions or discoveries if they are owned or controlled by the contractor and are incorporated in the material supplied under the contract. Wherever possible, a development contract is entered into on a fixed-price basis. However, a letter purchase order or letter of intent is frequently issued to permit initiation of the work without delay and to safeguard the interests of the Government and of the contractor until such time as the formal definitive fixed-price contract can be executed.

Upon delivery of the pilot models, thorough tests are made, usually with the assistance of the development contractor. Where necessary and desirable in the judgment of the De-

THE NEW WEAPON IS MADE ALMOST ENTIRELY OF STAMPINGS AND CAN BE PRODUCED FOR LESS THAN TWENTY DOLLARS

partment, the contractor is requested to make changes in the pilots as a result of such tests.

Many submachine guns designed and developed either by an individual inventor or by the small or large manufacturer have been submitted to the Ordnance Department for inspection and test. After preliminary inspection, should the gun submitted warrant further consideration, it is sent to the Aberdeen Proving Ground for test. In order to maintain records, photographs are taken of the gun from various angles, field-stripped and completely disassembled. The gun is given preliminary function firing of approximately 200 rounds in order to determine that it is in good operating condition. The cyclic rate of fire is then determined by an electrical impulse-recording instrument.

THE gun is submitted to a dust test wherein a charged magazine is inserted in the magazine housing, the muzzle end of the barrel covered with tape and the gun suspended in a standard dust box. The gun so arranged is exposed to a mixture of very fine sand and dust agitated by means of a hand blower for a period of two minutes. It is then removed, the tape taken off the muzzle end of the barrel, and cleaned by wiping with the bare hands or blowing with the mouth. The bolt is not retracted during this operation, nor are any rags used for cleaning. An attempt is made to fire the gun, first with the dusted magazine and then with a clean, freshly loaded magazine. In order to pass this test the gun must, without incident, fire the complete dusted magazine and three clean magazines.

The gun is completely disassembled, cleaned, lightly oiled, reassembled, and submitted to the standard mud test. It is prepared for this test in the same manner as in the dust test described above and submerged in a trough filled with mud of a semiliquid consistency. It is turned over from side to side and the mud is stirred over the gun. After removal from the mud, the tape is taken from the muzzle end of the barrel and no cleaning is permitted other than by wiping with the bare hands. An attempt is made to fire the piece first with the muddy loaded magazine and then with a clean, freshly loaded magazine. In order to pass this test, the weapon must fire without incident one complete loaded muddy magazine and three clean loaded magazines.

Upon completion of the mud test, the weapon is again completely disassembled and submitted to a simulated rain test. A garden hose with a nozzle adjusted to permit a medium-fine spray is held approximately six inches from the gun and directed on the breech opening. The gun must fire a minimum of 200 rounds under a continual spray of water without any malfunctions whatsoever.

All these tests are performed in order to determine the reliability of the weapon under adverse conditions. They are followed by a rigid accuracy and functioning test. The submachine gun is mounted in a fixed rest and fired at a range of one hundred yards. Three targets of ten rounds each in automatic fire are followed by three targets of ten rounds each in semiautomatic fire. The accuracy of the weapon determined from these targets is not a true indication of what the weapon will do in the hands of a soldier but is merely a check of the barrel and rifling. To check the actual accuracy, ten targets of ten rounds each at fifty yards' range are fired in the full automatic, and ten targets of ten rounds each at one hundred yards' range are fired in the semiautomatic by a cross section of firers ranging from the novice to the expert.

IN the hands of troops performing tasks where the use of a submachine gun is required, the gun must operate with a minimum number of malfunctions. Therefore, in the standard submachine-gun test, 5,000 rounds are fired for endurance and function as follows: (1) Two thousand five hundred rounds are fired full automatic in increments of two hundred and fifty rounds as rapidly as possible—cooling is permitted

by the use of water after the completion of each 250-round increment, and the gun may then be lightly oiled; (2) The 2,500 rounds full-automatic firing is followed by 2,500 rounds semiautomatic and at the same rate and in a similar manner; (3) Five hundred rounds additional firing is done during which part of each magazine is fired full automatic and the remainder semiautomatic—during the firing of this five hundred rounds no cleaning or oiling is permitted.

In order to determine whether there is any change in rate of fire, measurements of cyclic rate under full-automatic condition are taken at several intervals during the firing of the full-automatic test described above. To conserve the facilities of the Aberdeen Proving Center and the expenditure of ammunition required for the extensive accuracy and endurance tests, a submitted weapon must successfully perform each of the preceding tests.

The M3 submachine gun has, in numerous tests by the various service boards, proved to be superior to previous American-made submachine guns as well as to those of our allies and our enemies. The M3 submachine gun was produced under development contract and is a good example of the speed and efficiency of teamwork.

THE need for such a weapon as the M3 submachine gun was first foreseen in July 1942 when it became evident that production capacity then available for submachine guns of the type required under war conditions was inadequate to meet the growing demand for such weapons. Expansion of existing facilities was out of the question. Machine-tool capacity was even then being diverted to high-priority projects. What was required, in effect, was a gun of improved performance characteristics that used neither the raw materials nor the machine tools normally required in gun manufacture.

Within four months an experimental gun which met these almost impossible requirements was ready for test. After engineering tests indicated that the new gun had extraordinary possibilities, it was tested in rapid succession by the Infantry, Parachute Troops, Amphibious Troops, Armored Force, and the Tank Destroyer Command.

The Infantry reported that in comparison with standard weapons the new submachine gun was more accurate, easier to control, had less recoil, and a slower rate of fire which made each shot more effective. The Parachute Troops preferred it because of its lighter weight and collapsible stock. The Amphibious Troops found that rain, salt spray, or even complete immersion in sea water had little effect on its reliability during landing operations. The Armored Force reported that even under conditions of excessive dust incident to tank operation in the desert it could be depended on to deliver accurate, deadly fire. The Tank Destroyer Command found that its sturdy, all-metal construction stood all the battering that a high-speed motorized gun mount could give it. At the climax to this series of tests the Ordnance Department stated that it was superior in all respects to every comparable foreign weapon.

So overwhelming was the superiority of the new submachine gun that it would not be possible to supply American soldiers with any other submachine gun and maintain a clear conscience. So carefully planned was the design and so well organized was the procurement program that less than ten months after the need for a new submachine gun was first established, the weapon was coming off the assembly line in large quantities and at an ever-increasing rate.

At 10 A.M. on April 30, 1943, the first of the U. S. Army's new guns came off the production line. Known officially as the M3 submachine gun, this weapon at first glance resembles the equipment used by "Buck Rogers." The outstanding features are: reliability of functioning, accuracy, portability, a low rate of fire, and endurance when operating under adverse conditions of mud, dust, and water. When it is field-stripped it can be packed in a box 12¾ by 7½ by 3⅜ inches. No tools are required in taking the gun down or assembling it. This weapon is simplicity itself. When disassembled there are only twenty-five component parts and seventy-three pieces made by the manufacturer (less magazine). It is all metal, fabricated mainly from stamped parts to take advantage of speed and economy of manufacture and assembly. As standardized, the M3 uses the standard caliber .45 ball-cartridge ammunition. A magazine feed of 30-shot capacity will fire at the rate of 450 rounds a minute.

The new gun employs the straight-blowback full-automatic principle. Single shots can be made by the quick depression and release of the trigger. This is possible because of the slow motion of the bolt and the low rate of fire. The bolt has a fixed firing pin and is so designed that the excess energy from its forward motion is expended simultaneously with the explosion of the cartridge. This available energy is to counteract the muzzle rise in recoil of the weapon, thus improving accuracy of fire. The gun has an 8-inch barrel, a sliding removable stock, and weighs eight pounds (less magazine). All working parts are fully enclosed to protect them from dirt, dust, mud, and water. There are no projecting moving parts to endanger the operator. The ejection port cover is also a safety device to insure a closed safe gun when it is not in use. The safety lug on the cover, when it is closed, locks the bolt on an empty chamber when it is forward. In the cocked position, the safety lug holds the bolt back off the sear and makes the sear and trigger both ineffective.

When this new M3 was standardized, former standard submachine guns were classified as limited standard. This action will gradually release facilities making the former weapons for the manufacture of other necessary items. This is possible because the M3 submachine gun can be produced without complicated machine tools, and since most of the components are made by the metal-stamping process, many facilities equipped to do this type of work, which have been previously unable to take part in the war effort, can be utilized.

The savings involved in switching to the exclusive manufacture of the new gun are enormous, whether viewed from the standpoint of money, man-hours, or machine tools. The first submachine gun bought by the Army in 1928 cost upward of $200. Fifteen years later, after several hundred thousand had been made, these same guns with comparatively few modifications cost about $40 apiece. Contrast these figures with a unit cost of less than $20, a 50 per cent reduction in man-hours, and a 25 per cent reduction in machine-tool requirements for the new submachine gun and you have a combination which means dollars to the taxpayer, man power to the Army, machinery to the manufacturer, and trouble to the Axis.

Although it would be dangerous to state that further improvements and developments are unlikely, the ultimate has been reached in this type weapon for the time being, and production has begun without fear of immediate changes. The United States Army now has for its standard submachine gun a simple, rugged weapon possessing superior stability and accuracy.

Desert Salvage

An Account of the First U. S. Ammunition Detachment in Africa

Lieut. Col. G. Burling Jarrett

DURING the late spring of 1942, it became apparent that the Ammunition Branch of the British Ordnance Services of G.H.Q., Middle East Forces, at Cairo, would need the help of an American ammunition detachment. It was agreed that Col. Earl S. Gruver, Ordnance Officer of the U. S. Headquarters in Cairo under Maj. Gen. R. L. Maxwell, would ask for this personnel. Thus, late in September, such an American unit arrived in Cairo. This unit was a highly specialized group which had been gathered together from the Ordnance School personnel pool at Aberdeen. The officers and men were all experienced in some phase of ammunition work.

MEMBERS OF THE ORDNANCE DETACHMENT EXAMINE CAPTURED GERMAN 88-MM. AMMUNITION

The group consisted of four officers and sixteen enlisted men. One officer was eventually retained to replace then Maj. G. B. Jarrett, who was under orders to return to the United States. The remaining three who went with the British Ammunition Branch were Captain Jones, senior officer, Captain Leighty, and Lieutenant McKewen, all Ordnance officers. The officers were flown over; the men, starting much earlier, arrived by boat about the same time. As soon as possible the unit was organized and attached to the Delta Service Command, U. S. Army Forces in the Middle East. For administration they came under the U. S. Port Quartermaster officer at Suez.

Necessary equipment and supplies were drawn from the U. S. Quartermaster warehouses and, loading equipment and unit into trucks, Major Jarrett took them to the famed No. 9, B. A. D. (Base Ammunition Depot), where they were quartered. This is one of the largest British base ammunition depots in the Middle East. It is along the Suez Canal and receives its bulk stock deliveries directly from the ships going through the Canal. Colonel Arnold-Edward, Deputy Director of Ordnance Services—Ammunition, British Army, was responsible for the long-range plans set up for this American unit. He came down from headquarters at Cairo with the unit on the occasion of its installation. Lieutenant Colonel Sheddon, of No. 9, Base Ammunition Depot, welcomed the unit and had provided the best facilities available.

The reader should understand that the No. 9 Depot had been created amid a trackless waste of sand along the edge of the Bitter Lakes, through which passes the Suez Canal channel. The tenacity in clinging to such an area and its organization were typically British. It was an excellent post, and while in the desert had a beauty and charm all its own. The lake with its gorgeous aquamarine color, the sandy shore, and the solitude leave a never-ending pleasant memory with all who ever set foot in No. 9, B. A. D. Thus the American unit found it and came to love it as their home.

As one can visualize, the British with their already long period in the war were rather tightly rationed. The basic British ration is considerably less in size and variety than the American. Thus at mess time the Americans were a bit surprised, and it took typical American courage to adapt themselves. An amusing incident was afforded when Colonel Sheddon, who took a personal interest in the detachment, asked one of the boys how the mess was. The reply was to the effect that it was "fair but not very much of it." Colonel Sheddon, in defense, remarked that they (the British) had had four cuts in the ration allowance since the start of the war, which is, of course, true. The American soldier respectfully replied, maybe so but for him and his pals it was a big cut—"and all at once." Colonel Sheddon, by his fatherly interest for all under him, soon made the British and American soldiers comrades.

The American officers were of the type to get along with the British officers, and excellent times were had in the officers' mess. Considerable credit goes to Colonel Arnold-Edward for his foresight in planning the joint activities and to Colonel Sheddon for carrying them out.

The job of the American unit was to help the British units by relieving them of inspecting American ammunition. This the American detachment now started to do. It was done by American methods but conformed as nearly as possible to British practice and needs—it should be remembered that this American detachment was working for the British. The weeks soon rolled around and with the 26th of October the great battle at Alamein commenced. Daba was captured early in November. Colonel Arnold-Edward, accompanied by Major Jarrett, went into the forward areas to follow the Eighth Army. Their mission was to check the captured enemy ammunition stocks and the recaptured allied rounds. This trip took up most of November. It involved checking the recaptured former British dumps which now contained some remaining British rounds and thousands of tons of German ammunition of all types.

The main German forward area depot was at Daba, which had been a former British reserve depot in the early campaigns of Wavell in 1940. Here the British in 1938 had

---

Colonel Jarrett is now chief of the Foreign Matériel Museum, Aberdeen Proving Ground, Md., under Col. Scott B. Ritchie, chief of the Service Branch, Ordnance Department Technical Division. While in the Middle East, Colonel Jarrett was on the staff of Maj. Gen. R. L. Maxwell and was adviser to the British on American ammunition.

placed about 500 tons of ammunition. This site was a part of the strategic defense plans for the Delta and the Nile Valley created by Colonel Arnold-Edward. In the summer retreat it had been a bitter loss to blow this big dump. Thus, when visited in November, it was a sorry sight of blown British and American rounds and general twisted wreckage—a mass of well-nigh indescribable litter.

The depot was served by rail, being on the Alexandria-Mersa Matrûh line of the Egyptian State Railway. After the Eighth Army's retreat, the Germans used captured E. S. R. rolling stock, while the locomotives were brought from Italy. The British in early 1942 had pushed this railway from Mersa Matrûh almost to Tobruk. The last bit of track from El Adein to Tobruk the Germans completed. Thus their railway ran from Tobruk to Daba. Shifting engines had actually been made out of captured British trucks to which had been welded bumpers for pushing the rolling stock. Flanged wheels had been attached. This had all been local German ordnance company work done on the spot in Africa. German resourcefulness and their use of the welding torch are always in evidence amid captured areas and abandoned equipment.

As these inspecting officers examined the big depot they found that the Germans had gone into the blasted areas and set up their ammunition stocks amid the debris of British rounds. The Germans made no attempt to blow this depot when they retreated—apparently they never were allowed the time due to the terrific allied air raids. A British ammunition unit moved into the area within a day of its evacuation and immediately went to work sorting out the many types of ammunition.

It became apparent that as American rounds were spread through all this mess the new American ammunition unit should move into the area. As an important job was in progress under American direction at No. 9, B. A. D., only half the unit was moved forward at first. Thus, late in November, Major Jarrett took Lieutenant McKewen and six men forward to Daba. Here the Americans found stacks of ammunition rounds intended for the Grant tanks as well as some British types. Some had been blown up, others were untouched by the great blast set by the British. The Germans had made a considerable effort to sort out much of this ammunition to use with various captured weapons. Piles of German rounds were irregularly stacked amid the vast devastated areas. This really was excellent camouflage, and during the summer it was quite difficult for observing allied airmen to ascertain just how much active use the Germans were making of the old depot. However, the R. A. F. and the 9th U. S. Air Force kept the area under attack at all times.

The first job of the American unit was to fix up a bivouac area. The British unit was spread out in their "bivies" or pup tents with a mess hut at one end of the camp. The British officers had two large tents erected and Lieutenant McKewen occupied one with Lieutenant Saunders, the British O. C. The American enlisted men built a squad tent. This was quite a job as they dug in four feet deep and built a shelter over the top from salvaged materials and covered it with German canvas 'paulins. The combined mess was better than usual and the cook was an old hand at the job. To add to the menu were captured food stocks which included grapefruit, the existence of which will always be a mystery. Where had the Nazis obtained such on their bill of fare? The British Army enjoyed excellent grapefruit for several weeks. There were also some excellent brands of tinned fish, beans, and chocolates, all *à la* Hitler.

The first few days were consumed by getting suitable quarters established, then a work program was set up. First, all serviceable British and American rounds were located and checked. If in good condition, they were made ready for shipment forward. If unusable, they were segregated for eventual destruction. There were around 5,000 tons of German captured ammunition in this depot, and perhaps 1,500 tons of British and American rounds were recovered. The Germans had made their stacks seldom over two packages high with sand piled on top. This was good camouflage and kept the temperatures cooler and more even.

Calibers from small arms to 17 cm. (about 7 inches) were identified. Both old and new shell patterns were also noted. For example, high-explosive shells for the old 1913 15-cm. Krupp howitzer were found. It will be remembered that the late summer battles revealed the Germans had put this old howitzer on a captured French Lorraine tank chassis as a support artillery weapon. A sizable supply of its ammunition was present at this Daba depot. The cartridge cases were of steel and of recent manufacture, but the shells were old types with modern fuzes.

THE American group worked along side by side with the British unit and gradually became well informed on enemy as well as British ammunition. It was a grand opportunity for a rare and unusual course on ammunition. In one section of the former British installation there was a large stock of French rounds. Some of this had been thoroughly destroyed, but one pile of small-arms ammunition was salvaged. These were French 7.5-mm. rifle rounds and were needed by Fighting French units.

The unit helped clean up the Daba area and following the Eighth Army's footsteps further forward worked on other depots. In all, perhaps 50,000 tons of German and Italian ammunition were taken between El Daba and Benghazi. At Tobruk about 6,000 rounds of a certain kind of 75-mm. ammunition were recovered. Early in 1942, when the Grant tanks were just arriving in the Middle East, all ammunition for these tanks was scarce. Fairly large stocks of 75-mm. field-gun high-explosive ammunition did exist in the Middle East but not necessarily intended for these tanks. At the same time, perhaps 15,000 German 75-mm. armor-piercing, high-explosive rounds had been captured in the battles of the winter of 1941-1942. These were then broken down, and, as the rotating bands needed only a slight modification, they were reseated in the cartridge cases for the Grant 75-mm. gun. Incidentally, these shells proved quite satisfactory on tests, but they did not reach the forward areas until a bit too late to be of effective assistance in the big battles of May and June along the old Gazala-Bir Hachéim line. Thus the Tobruk ammunition dump contained many of these rounds when it fell late in June. They were known as composite rounds, and it was often wondered what the Nazis thought on seeing them. It would have been a good job for Hitler's Gestapo to decipher! However, these rounds, some of which had to be one hundred per cent checked, were then hurried forward for Montgomery's tanks. It is believed they were gotten into action at El Aghéila.

This American Ordnance unit thus played an important part in the rout and final defeat of Rommel's Afrika Korps, and it really was in on the inside story of some amazing events those last days of 1942.

ARMY ORDNANCE

Founded 1920

Published Bimonthly by
THE ARMY ORDNANCE ASSOCIATION
WASHINGTON 6, D. C.

Col. J. L. Walsh, Founder and Editor, 1920-1922
Brig. Gen. R. H. Somers, Editor, 1922-1925
Maj. Gen. R. L. Maxwell, Editor, 1925-1926
Col. C. R. Baxter, Editor, 1926-1929
Col. L. A. Codd, Editor, 1929-1942

Editor: Brig. Gen. R. H. Somers, U. S. Army, Ret.
Associate Editor: R. E. Lewis, Jr.
Editorial Staff: F. G. Ferriter, N. A. Woodhouse, M. E. Ferriter, J. C. Dunbar.

The views and statements expressed in the articles and advertisements in ARMY ORDNANCE *are those of the authors and advertisers only and do not represent official War Department policy.*

SEPTEMBER-OCTOBER, 1943

Month by Month

War Production.—Military production, exclusive of aircraft, is increasing at the rate of $100,000,000 a month, and is expected to total $21,000,000,000 for the full year of 1943, Maj. Gen. Lucius D. Clay, Director of Matériel, Army Service Forces, stated recently in a commencement address at the Valley Forge Military Academy, Wayne, Pa. General Clay pointed out that scheduled production exceeded $1,600,000,000 for the month of May alone and that the current rate is meeting the expressed requirements of the United Nations and the operational needs of the United States forces. He added, however, that American troops in training are not yet fully equipped and will not be until 1944.

Comparing current production with World War totals, General Clay said that the number of machine guns now being produced each month is more than triple the monthly maximum of 22,000 for machine guns of corresponding caliber produced here for the United States and the Allies in 1918. General Clay said that the demand for huge quantities of materials and supplies will continue, because of ever-increasing operational demands from the combat areas. Nevertheless, he emphasized, quantity of output has not been obtained at the expense of quality.

Under Secretary of War Patterson, however, seemed less encouraged. He announced that war production is behind schedule, and warned the Nation that it must buckle down to the job of producing war materials or the opportunity to exploit recent military successes will be lost.

"The War Department is concerned over the Army production situation," he said. "Production in May of matériel for the Ground Forces supply program, which was scheduled to rise 2 per cent from $1,553,000,000 in April to $1,582,000,000 in May, actually declined 3½ per cent to $1,494,000,000. With the exception of aircraft, and radio equipment for the Ground Forces, deliveries of every single group of Army supply items were either below May schedules or below April totals."

He said the failure in production meant troops in training had to be deprived of equipment to supply troops overseas. If the situation continues, even overseas troops will suffer shortages, he added.

"I would attribute the letdown in May," he continued, "to overconfidence inspired by the Tunisian victory and the success of European bombing; to baseless rumors of vast quantities of Army supplies being stored up here in America, far beyond our abilities to transport overseas; and to the mistaken belief on the part of many that materials in great quantities will shortly become available for the conversion of many war facilities to the production of less essential civilian items." He also mentioned the effect of the Midwest floods and the strike situation as contributing factors.

The Munitions Program.—The United States over-all 1943 war program set early this year amounted to $106,000,000,000—80 per cent more than the $59,000,000,000 total for 1942.

This statement is contained in a formal report on war production progress for 1942 and prospects for 1943 made to President Roosevelt by Donald M. Nelson, chairman of the War Production Board, and summarized in a report by the Office of War Information. The two figures cover the total war program—including munitions, construction, and such nonmunitions items as pay, subsistence, and others. "This record could not have been achieved in so short a time," Mr. Nelson said, "had we not taken some short cuts, made some compromises, and assumed some risks."

The report itself—which is secret, for security reasons—stresses the fact that the task posed for the industrial system by the 1943 military production program is most formidable. Among difficulties are the continued tightness of many materials, the increasing man-power problems, and, in general, the fuller impact of the production program on the civilian economy. The report also mentions the growing need to give thought to postwar considerations.

The 1942 total war program of $59,000,000,000 equaled 3½ times the 1941 figure of $16,500,000,000. Munitions formed 55 per cent of the total war program. The output of munitions in 1942 was $32,500,000,000—a dramatic increase over the $8,400,000,000 recorded in 1941. Principal components of the 1942 total were aircraft, ships, ground ordnance, and miscellaneous (military automobiles, clothing, and other equipment).

The value of aircraft and related munitions increased from $2,200,000,000 in 1941 to $9,200,000,000 in 1942. The output of Navy, Army, and merchant vessels, including naval ordnance and other naval equipment, increased at about the same rate as aircraft, the sharpest rise being in the production of merchant vessels. Throughout 1942, aircraft and re-

lated equipment comprised about 30 per cent of total munitions. During the year, bombers took precedence over other types of aircraft as the result of war needs.

Basic over-all goals for war production during 1942 and 1943 were established by the President in his January 1942 message to Congress. These were as follows:

Year	*Planes*	*Tanks*	*Antiaircraft Guns*	*Merchant Ships*
1942—	60,000	45,000	20,000	8,000,000 tons
1943—	125,000	75,000	35,000	10,000,000 tons
Total:	185,000	120,000	55,000	18,000,000 tons

The President's message of January 1943 indicated that these production objectives had been changed—some adjusted upward, and others downward; some items taken out of the program entirely, and others added. For example, he cited the revision of the tank production schedule: "As a result of hard experience in battle, we have diverted a portion of our tank-producing capacity to a stepped-up production of . . . self-propelled artillery."

On January 2, 1943, the Army, Navy, and WPB established the following 1943 goals, in terms of relative proportion to 1942: Munitions production in general, double 1942; Airplanes, double in number, four times the weight of 1942; Merchant shipping, twice 1942 tonnage; Expenditures, twice 1942 amount (approximately $88,000,000,000); Naval escort vessels, considerable increase; Naval combat vessels, increased (Under Secretary of Navy Forrestal in February established double the 1942 rate as the goal). Other more recent ship-production achievements announced were: Merchant shipping for 1942, 12,000,000 tons (goal for 1943, 19-20,000,000 tons).

The following production figures on important matériel were achieved in January and February: Machine guns, 150,000; Submachine guns, 134,000; Tanks, 5,000; Army trucks, 28,000; Antitank guns, 2,000; Weapon-bearing combat vehicles (February), 7,800.

The production of aircraft was even more encouraging. WPB Vice-Chairman Wilson on June 11th stated that production for May totaled 7,000 planes and that 8,000 were scheduled for June. On June 25th, Gen. H. H. Arnold, Commanding General, Army Air Forces, estimated that 115,000 aircraft would be produced in the next 12 months.

Also of interest is the fact that the Army's metal-saving experiment in an all-wood transport plane has been discontinued with the cancellation of two large contracts for the Curtiss Caravan C-76 which had been placed with the Curtiss-Wright Company and the Higgins Company. Both organizations will now turn to the manufacture of the all-metal Curtiss Commando C-46. The Army found the wooden ship more costly to build and less efficient than metal airplanes.

Army and Navy Staff College Established.—An Army and Navy Staff College, functioning as an agency of the Joint Chiefs of Staff for the training of senior officers of the Army, Navy, and Marine Corps in all phases of joint or coördinated operations involving land, sea, and air, was established recently by the War and Navy Departments. Air operations, and the logistics involved in combined operations, will be stressed. The course will be of four months' duration, divided into two phases. The students, specially selected, will normally be in the grades of lieutenant colonel and colonel in the Army and Marine Corps and the corresponding grades of commander and captain in the Navy.

In the first phase of the course, officers selected by the Navy will spend one month at the Command and General Staff School at Fort Leavenworth, Kans., and one month at the Army Air Corps School of Applied Tactics at Orlando, Fla. Concurrently, officers of the Army Air Forces will spend one month at the Command and General Staff School, and one month at the Naval War College at Newport, R. I., and officers of the Army Ground Forces will spend one month at the Air Corps School of Applied Tactics and one month at the Naval War College.

The second phase of the course, for all the selected officers of the Army, Navy, and Marine Corps, will consist of two months of special studies, in accordance with a curriculum devised by the Joint Chiefs of Staff and administered by a faculty of officers designated by them, at Georgetown University, Washington, D. C. One-third of the officers designated for this training by each of the armed services will be air officers.

Industrial Facilities.—The value of war industrial facilities financed with public and private funds reached $19,339,000,000 by the end of March, according to the War Production Board. This includes all projects for which contracts have been let since June 1940.

In general, this sets the framework of the war-facilities program. Virtually all projects designed for war purposes have been placed under commitment, except those which may be necessitated by future modifications of the military program or equipment model changes and those which may be required to maintain the Nation's war plant at capacity operation.

Of the total, $15,140,000,000 worth was financed by Government funds, while the balance of $4,199,000,000 was privately financed. These facilities include those whose estimated cost was more than $25,000 and were the direct obligations of the War and Navy Departments, Maritime Commission, Defense Plant Corporation, United Kingdom, and loans of the Reconstruction Finance Corporation. These figures indicate that to the end of March, seventy-eight per cent of the new industrial facilities financed since June 1940 were financed from Government funds, while twenty-two per cent were privately financed.

The largest item was for ordnance—including guns, ammunition, and explosives—which called for the construction of factories estimated to cost nearly $5,000,000,000, or 26 per cent of all facility expansion. In this area, less than five per cent of the financing was with private funds.

The next largest grouping is for aircraft, aircraft engines, parts, and accessories, for which $3,327,000,000 has been committed. In this area, seven per cent of the financing was from private funds. This group represents seventeen per cent of the total cost of war facilities.

Ship construction and repair facilities amounting to $2,086,000,000 were built or are being constructed from Government funds. In this instance, five per cent of the funds came from private sources.

The highest proportion of private funds occurred in non-manufacturing facilities—power lines, mining, transportation, etc.—the total in this area amounting to almost nine per cent of the total funds for war industrial facilities.

Association Affairs

New National Directors

THREE new names have been added recently to the roster of national directors of the Association. The new officials are: Congressman James W. Wadsworth, of Geneseo, N. Y.; Col. H. W. Alden, chief engineer of the Timken-Detroit Axle Company, Detroit, Mich., and president of the Detroit Post of the Association; and John D. Biggers, of Toledo, Ohio, president of the Fargo Division of Chrysler Corporation. ARMY ORDNANCE takes this opportunity to welcome these three distinguished gentlemen to the Association's directorate.

Texas Post

THE first dinner meeting of the Texas Post since its organization last fall was held at the Rice Hotel, Houston, Tex., on the evening of July 20, 1943, and was attended by more than 175 members and guests, including Army officers and ordnance manufacturers from all sections of Texas. B. T. McNeil, newly elected president of the Post, acted as toastmaster and chairman.

Col. Merle H. Davis, chief of the St. Louis Ordnance District, introduced Brig. Gen. Hermon F. Safford, chief of the Production Service Branch, Office of the Chief of Ordnance, who spoke on "American Ordnance on the Battle Front." General Safford gave a brief but vivid picture of the meteoric rise in the production of ordnance matériel in the United States during the past two years. He pointed out that American industry had demonstrated its ingenuity and loyalty in effecting plant conversions and reaching high production schedules in a relatively short period. General Safford reminded those present that they not only were supplying the United States forces but also were supplying vast quantities of matériel to all the United Nations.

"Item for item, American ordnance is equal or superior to that used by any army of either the allied or Axis nations," said General Safford. In closing his address, he made a plea for the continued assistance and support of industry, not only for the duration of the present emergency but throughout the years ahead when there may be a tendency to forget the Ordnance program.

Among those present at the meeting were: Col. L. M. Bricker, Ordnance Officer for the Third Army, and R. E. Gardner, deputy chief of the St. Louis Ordnance District.

At a meeting of the board of directors of the Post held on June 14th, Mr. McNeil, of the McEvoy Company, Houston, and formerly vice-president of the Post, was named president to succeed W. J. Gourley, former president, who resigned. William R. England, of Houston, was chosen vice-president to succeed Mr. McNeil. These are *ad interim* changes and will be effective until the Post's annual election of officers in October.

Chicago Post

ON Monday, June 21st, the Chicago Post of the Association held a luncheon in the grand ballroom of the Palmer House in Chicago in honor of Maj. Gen. Levin H. Campbell, Jr., Chief of Ordnance.

Lieut. Col. Francis W. Parker, Jr., vice-president of the Post, presided at the luncheon which was attended by nearly 700 members and guests. The principal speakers were Col. Robert R. McCormick, editor and publisher of the Chicago *Tribune*, and General Campbell.

The following also were seated at the speakers' table: Brig. Gen. Charles G. Dawes, chairman of the board, City National Bank & Trust Company; Col. John F. Davis, chief of staff, Sixth Service Command; Col. F. H. Miles, explosives and safety branch, Chicago Ordnance District; Lieut. Col. E. P. Russell, Office of the Chief of Ordnance, who accompanied General Campbell; H. W. Coes, president, American Society of Mechanical Engineers; and the following directors of the Chicago Post: Brig. Gen. Thomas S. Hammond, chief of the Chicago Ordnance District; Lieut. Col. W. H. Damon of the Northern Trust Company; W. E. Crocombe, president, American Forge Division of American Brake Shoe & Foundry Company; Sterling Morton, secretary and treasurer of the Morton Salt Company; Fred A. Preston, vice-president of Poor & Company; William R. Wright, manager of Ford, Bacon & Davis.

Boston Post

AT a meeting of the Boston Post of the Association held in John Hancock Hall, Boston, on June 4th, President Carl P. Dennett appointed a nominating committee consisting of Lieut. Col. Harry W. Bagnall, chairman, Col. C. E. Fuller, and Alf Anderson to bring in a slate of officers to be voted on at the fall meeting of the Post. Announcement also was made of the appointment of Maj. R. E. Ratigan, Boston Ordnance District, to fill the vacancy in the office of secretary-treasurer caused by the resignation of Maj. Philip E. Gruber.

By unanimous vote, the Post extended its thanks to the members of the committee who arranged the Ordnance exhibit at the Hotel Statler sponsored jointly by the Post and the American Society for Metals. The committee consisted of Brig. Gen. Burton O. Lewis, Capt. William J. Peterson, and Felix W. Knauth.

The principal speaker of the evening was Col. Crosby Field, technical director, Safety and Security Branch, Office of the Chief of Ordnance, who gave an illustrated talk on the subject "Explosions I Have Met." Colonel Field's talk, which was well received, explained the methods by which the Safety and Security Branch has reduced the possibility of explosions in various powder plants throughout the country. Through the courtesy of 20th Century-Fox Film Corporation, the British film, "Desert Victory," was shown to conclude the meeting.

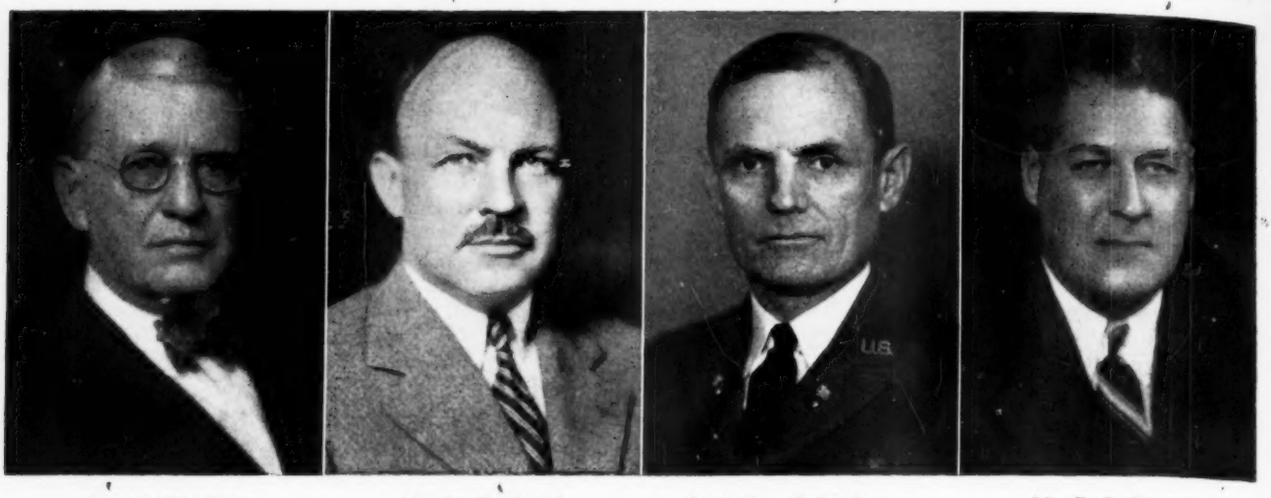
Detroit Post

THE Detroit Post of the Association, founded last December 12th, held its inaugural dinner meeting in the grand ballroom of the Book-Cadillac Hotel, Detroit, on June 18th. More than 500 members of the Association, industrial leaders of the Detroit area, and Army officers attended. Col. Herbert W. Alden, president of the Post and a national director of the Association, presided.

The principal speakers of the evening were Col. L. A. Codd, former executive vice-president and secretary of the Army Ordnance Association and managing editor of ARMY ORDNANCE, now executive assistant to the Chief of Ordnance; and Maj. Gen. G. M. Barnes, chief of the Technical Division of the Ordnance Department. Colonel Codd, in speaking on "The Army Ordnance Association—Past, Present, and Future," outlined the work of the organization since its inception and described the challenge which faces its members in the future to continue the development of ordnance manufacturing methods against the time when such "know how" may again be needed.

General Barnes recounted his experiences on his inspection tour of the North African battlefields and praised ordnance manufacturers for the quality and quantity of their products which so successfully passed the grueling test of combat. (General Barnes' address is published in full on page 327 of this issue.)

Also seated at the speakers' table were: S. T. Stackpole, Pennsylvania Railroad Company; Maj. H. S. Turner, Jr., Office of the Chief of Ordnance; C. T. Bush, Chas. A. Strelinger Company; R. K. Evans, General Motors Corporation; W. G.



Col. H. W. Alden
President

Mr. E. T. Gushée
Vice-President

Maj. Gen. G. M. Barnes
Speaker

Mr. R. L. Biggers
Committee Chairman

OFFICIALS AND PRINCIPAL SPEAKER AT DETROIT POST MEETING

Lerchen, Watling, Lerchen & Company; L. S. Sheldrick, Ford Motor Company; Capt. Norman C. Gillette, U.S.N., U. S. Naval Arsenal, Detroit; F. M. Zeder, Chrysler Corporation; R. C. Enos, Standard Steel Spring Company; Brig. Gen. A. B. Quinton, Jr., chief, Detroit Ordnance District; K. T. Keller, Chrysler Corporation; Brig. Gen. A. R. Glancy, chief, Tank-Automotive Center; C. L. McCuen, General Motors Corporation; Brig. Gen. R. H. Somers, secretary, Army Ordnance Association; Edward T. Gushée, Detroit Edison Company; Brig. Gen. S. E. Reimel, Tank-Automotive Center; C. J. Reese, Continental Motors Corporation; W. B. Brown, Briggs Manufacturing Company; Col. A. M. Krech, District No. 1, Sixth Service Command; W. H. Farr, Budd Wheel Company; Phil Huber, Ex-Cell-O Corporation; and Capt. J. W. Paynter, Detroit Ordnance District.

"ORDNANCE FOR VICTORY"

THE greatest public display of arms, armor, and ammunition ever opened to the public was inaugurated on Friday, July 23rd when executives of the Philadelphia Ordnance District, Army officers, and ranking industrialists attended a special dinner in the John Wanamaker store in Philadelphia where 80,000 square feet of floor space were devoted to the exhibits.

The "Ordnance for Victory" display was under the joint auspices of the Philadelphia District, headed by Col. David N. Hauseman, and a citizens' committee headed by Howard L. Adams, Philadelphia industrialist. Eighty-three manufacturers were represented by the guns, bombs, trucks, and manufacturing displays.

Present at the inaugural dinner were seventy officers of the Philadelphia Ordnance District, five officials of each of the exhibiting companies, and fifteen members of the Wanamaker store staff. Speakers included Lowell Thomas, news commentator; Hon. Edward Martin, Governor of Pennsylvania; Hon. Bernard Samuel, Acting Mayor of Philadelphia; Colonel Hauseman; Hugh Adams, general director of the exhibition; Congressman John E. Sheridan, chairman of the House Military Affairs Committee; and Maj. Gen. G. M. Barnes, chief of the Ordnance Department's Technical Division.

NECROLOGY

GOULD GRANT RHEUBY, who had retired as vice-president, director, and member of the finance committee of Hercules Powder Company on January 27, 1943, died July 28th at his home, Felicity Farm, Glen Mills, Pa., at the age of 74. Judge Rheuby had served the Hercules Company since April 1, 1913, only three months after it had commenced business. He had been a member of the Army Ordnance Association since 1924.

Judge Rheuby, who was judge of the 47th Judicial Circuit of Indiana from 1904 to 1909, joined Hercules as its general counsel in 1913 and held that post until March 31, 1939. On March 5, 1918, he was elected a member of the board of directors and also became a vice-president in 1930. In September 1928, he was named to the finance and executive committees.

Born on a farm in Eugene, Ind., on August 6, 1868, Judge Rheuby attended the University of Indiana and received his LL.B. in 1894, a year after he was admitted to the state bar. After teaching in Perryville and Cayuga, Ind., for five years, he practiced law in the Vermillion, Vigo, and Park circuit courts. In 1900, he was elected prosecution attorney of the 47th Judicial Circuit in Indiana, serving until he was elected judge in 1904. He left the Indiana bench in August 1909 to become assistant general counsel of the Du Pont Company in Wilmington, Del., where he remained until he joined the then newly organized Hercules Powder Company.

COL. LEONARD SHERMAN HORNER, a veteran of two wars and industrial adviser for the American Hardware Association, died on August 1st in Wolfeboro, N. H., at the age of 68.

A native of Warrenton, Va., Colonel Horner was graduated from Lehigh University in 1898. Upon graduation he began his career as an electrical engineer with the American Telephone & Telegraph Company.

In 1930 he became vice-president of the Bullard Company, Bridgeport machine-tool manufacturers, a position he held until he became associated with the American Hardware Association.

NOTICE also has been received of the deaths of the following members of the Association: P. D. Block, Chicago, Ill.; Peter S. Carlson, Ayer, Mass.; G. Walter Carpenter, Greenfield, Mass.; David E. Doyle, Philadelphia, Pa.; C. B. Ellis, Pittsburgh, Pa.; John W. Glover, Marietta, Ga.; Walter L. Heughes, Rochester, N. Y.; Robert F. McDuffee, Toledo, Ohio; Adolph L. Rosenheimer, Jr., Kewaskum, Wis.; Jerome K. Swinford, Houston, Tex.; Harry J. Watling, Hazelcrest, Ill. To their relatives and friends, ARMY ORDNANCE, on behalf of the Association membership, extends condolences.

THE ORDNANCE ENDOWMENT HONOR ROLL

ARMY ORDNANCE ASSOCIATION

WASHINGTON

THE immediate aim of the Army Ordnance Association is victory for our Armed Forces through armament research, production, and supply. To this purpose are dedicated the more than fifteen thousand members of the Association and its twenty-two local chapters. The long-range objectives of the Association are that American industry continue to know its growing responsibilities to the national defense; that engineering and technical developments of ordnance for our fighting forces advance at all times; that the United States of America exert a strong influence for peace through armament preparedness.

The Board of Directors of the Association, at their annual meeting in February 1941, unanimously resolved to seek an endowment fund of $500,000 to guarantee the future of the organization and its effectiveness in carrying out its objectives. Mr. T. M. Girdler was named chairman of the Endowment Committee, the roster of which was published in the November-December 1942 issue of ARMY ORDNANCE. *The first Endowment Honor Roll was published in the May-June 1942 issue. This second Honor Roll marks the conclusion of the campaign.*

As of August 19, 1943, the Ordnance Endowment Fund totaled $488,493.81. The entire sum, together with all interest accruals, is invested in United States war bonds and is administered by the American Security and Trust Company of Washington, trustee. The following have contributed to the Endowment up to August 19, 1943. Any additional contributors will be listed later in a special Ordnance Endowment brochure.

Acklin Stamping Company
Acme Die & Machine Company
Acme Foundry Company
Advance Plating Company
Aetna-Standard Engineering Company
Ajax Manufacturing Company
Allegheny Ludlum Steel Corporation
Allen Manufacturing Company
Alliance Brass & Bronze Company
Allis-Chalmers Manufacturing Company
Aluminum Company of America
Aluminum Industries, Inc.
American Brass Company
American Car and Foundry Company
American Electrical Heater Company
American Forge Division
American Fork & Hoe Company
American Locomotive Company
American Metal Products Company
American Optical Company
American Radiator & Standard Sanitary Corporation
American Rolling Mill Company
American Seating Company
American Steel & Wire Company
American Steel Foundries
American Tool Works Company
American Twist Drill Company
Ames Auto Accessories, Inc.
Ames Baldwin Wyoming Company
Anchor Manufacturing Company
Anderson Manufacturing Company, Albert & J. M.
Associated Spring Corporation
Atlas Drop Forge Company
Atlas Imperial Diesel Engine Company
Atlas Powder Company
Auburn Central Manufacturing Corporation
Auto City Plating Company
Autocar Company
Babcock & Wilcox Company
B. and S. Screw Company
Baldwin Locomotive Works
Barney Machinery Company
Bauer Brothers Company
Bausch & Lomb Optical Company
Bay State Tool & Machine Company
Beaird Corporation, J. B.
Becker Company, R. A.
Bell & Howell Company
Belle City Malleable Iron Company
Beloit Iron Works

(Continued overleaf)

THE ORDNANCE ENDOWMENT HONOR ROLL

(Continued)

Bendix Aviation Corporation
Bickford Company, F. H.
Birdsboro Steel Foundry and Machine Company
Black & Decker Manufacturing Company
Blackhawk Engineering Company
Blanchard Machine Company
Blaw-Knox Company
Bliss & Laughlin, Inc.
Borg-Warner Corporation
Bossert Company
Boston Wire Stitcher Company
Boyer-Campbell Company
Bridgeport Brass Company
Briggs & Stratton Corporation
Briggs Manufacturing Company
Brockway Motor Company
Brown & Sharpe Manufacturing Company
Bryan, Wiley B.
Bryant Chucking Grinder Company
Buckeye Foundry Company
Buckeye Steel Castings Company
Bucyrus-Erie Company
Budd Manufacturing Company, Edward G.
Budd Wheel Company
Buell Die and Machine Company
Buffalo Bolt Company
Buffalo Forge Company
Buhl Sons Company
Builders Iron Foundry
Bundy Tubing Company
Burgess-Norton Manufacturing Company
Burlington Brass Works
Buschman Company, E. W.
Byron Jackson Company
Cadillac Tool & Die Company
Campbell, Wyant & Cannon Foundry Company
Carbo Tool & Die Company
Carnegie-Illinois Steel Corporation
Carpenter Steel Company
Carter Carburetor Corporation
Case Company, J. I.
Caterpillar Tractor Company
Century Machine Company
Chain Belt Company
Chaso Tool Company
Chattanooga Stamping & Enameling Company
Chicago Gear Works
Chrysler Corporation
Cincinnati Bickford Tool Company
Cincinnati Lathe & Tool Company
Cincinnati Milling Machine Company
Cincinnati Planer Company
Circo Products Company
Clark Equipment Company
Clearing Machine Corporation
Cleveland Tractor Company
Cleveland Twist Drill Company
Cleves Welding & Machining Service
Clifford-Jacobs Forging Company
Climax Molybdenum Company
Cobusco Steel Products
Cogsdill Twist Drill Company
Colman & Sons, Inc., Frederick
Colorado Fuel and Iron Corporation
Colt's Patent Fire Arms Manufacturing Company
Columbia Mills, Inc.
Columbia Steel Company
Combustion Engineering Company
Commercial Metals Treating, Inc.
Commercial Shearing & Stamping Company
Cone Automatic Machine Company
Conlon Corporation
Consolidated Machine Tool Corporation
Continental Motors Corporation
Continental Roll and Steel Foundry Company
Coolerator Company
Copperweld Steel Company
Cornell Forge Company
Corning Glass Works
Cortland Line Company
Crane Company
Cribben & Sexton Company
Crocker-Wheeler Electric Manufacturing Company
Crompton & Knowles Loom Works
Crouse-Hinds Company
Crowe Name Plate & Manufacturing Company
Curtis Screw Company
Cushman Motor Works
Cutler-Hammer, Inc.
Dahlstrom Metallic Door Company
Dalzen Tool & Manufacturing Company
Damascus Steel Products Corporation
Dayton Appliances Company
Dayton Forging & Heat Treating Company
Deere & Company
Denison Engineering Company
Despard, F. F.
Detroit Aluminum and Brass Corporation
Detroit Ball Bearing Company
Detroit Brass and Malleable Works
Detroit Harvester Company
Detroit Lubricator Company
Detrola Corporation
Diamond Iron Works, Inc.
Diamond Screw Products Company
Diamond T Motor Car Company
Dick Company, A. B.
Disston & Sons, Inc., Henry
Divine Brothers Company
Drexler Company, Chas.
Duncan Electric Manufacturing Company
Dunham, Dr. Kennon
Duofold, Inc.
Du Pont de Nemours & Company, E. I.
East Side Gear & Tool Company
Eastern Gas & Fuel Associates
Eastman Kodak Company
Eaton Manufacturing Company
Eclipse Machine Division
Economy Fuse & Manufacturing Company
Edgewater Steel Company
Edwards Manufacturing Company
Ehrhardt Tool & Machine Company
Ekman and Sons Tool Company
Electric Auto-Lite Company
Electric Household Utilities Corporation
Electric Machinery Manufacturing Company
Electromaster, Inc.
Elgin National Watch Company
Emeloid Company
Emerson Electric Manufacturing Company
Engineering Metal Products Corporation
Enterprise Aluminum Company
Enterprise Tool and Gear Corporation
Eureka Vacuum Cleaner Company
Evans Products Company
Ex-Cell-O Corporation
Fabricated Metal Products Company
Fairmont Railway Motors, Inc.
Falls Spring and Wire Company

THE ORDNANCE ENDOWMENT HONOR ROLL

Continued

Federal Electric Company
Federal Engineering Company
Federal-Mogul Corporation
Federal Motor Truck Company
Federal Screw Works
Ferro Stamping and Manufacturing Company
Fibre Forming Corporation
Finkl & Sons Company, A.
Flannery Bolt Company
Ford Motor Company
Fort Schuyler Knitting Company
Franz Tool Company
French & Hecht, Inc.
Fries Tool and Machine Works, Inc.
Frontier Bronze Corporation
Frost Company
Fruehauf Trailer Company
Fuller Supply Company
Gardner Machine Company
Gardner Publications, Inc.
Gar Wood Industries, Inc.
General American Transportation Corporation
General Electric Company
General Fireproofing Company
General Industries Company
General Metalware Company
General Motors Corporation
General Motors Truck & Coach Division
General Steel Castings Corporation
General Time Instruments Corporation
Gent Machine Company
Geometric Stamping Company
Geuder, Paeschke & Frey Company
Gilbert & Barker Manufacturing Company
Girdler Corporation
Gisholt Machine Company
Gleason Works
Globe-Union, Inc.
Gorham Manufacturing Company
Goss and de Leeuw Machine Company
Grandinetti Manufacturing Company, D.
Granite City Steel Company
Graphic Arts Arsenal
Gray Company
Great Lakes Steel Corporation
Greenfield Tap and Die Corporation
Guiberson Diesel Engine Company
Gulf Oil Corporation
Gummed Products Company
Hadley Special Tool Company
Hamilton Foundry & Machine Company
Hamilton Manufacturing Company
Hanna Paint Manufacturing Company
Hannifin Manufacturing Company
Hardinge Brothers, Inc.
Harnischfeger Corporation
Harrisburg Steel Corporation
Hart-Carter Company
Harvey Metal Corporation
Hedstrom Corporation, Oscar W.
Heil Company
Hein-Werner Motor Parts Corporation
Hendey Machine Company
Heppenstall Company
Hercules Body Company
Hercules Motors Corporation
Hermann Manufacturing Company
Herschede Hall Clock Company
Hershey Metal Products Company
Hess & Eisenhardt Manufacturing Company
Heywood-Wakefield Company
High Speed Hammer Company
High Standard Manufacturing Company
Hillerich & Bradsby Company
Hinkl, F. W.
Hobart Brothers Company
Hobart Manufacturing Company
Hoe & Company, R.
Holcomb & Hoke Manufacturing Company
Holley Carburetor Company
Hooker Electrochemical Company
Hoover Company
Horrocks-Ibbotson Company
Hosdreg Company
Houdaille-Hershey Corporation
Hudson Sharp Machine Company
Hughes-Keenan Company
Humble Oil & Refining Company
Huther Brothers Saw Manufacturing Company
Hygrade Products Company
Independent Lock Company
Indiana Forge & Machine Company
Industrial Metal Fabricators, Inc.
Industrial Tool & Die Works, Inc.
Inland Steel Company
International Business Machines Corporation
International Harvester Company
International Nickel Company
International Register Company
International Tool Company
Interstate Folding Box Company
Jackson Steel Tube Company
Jacobs Company, F. L.
Jessop Steel Company
Jones & Laughlin Steel Corporation
Joy Manufacturing Company
Kalamazoo Stove & Furnace Company
Katzinger Company, Edward
Kearney & Trecker Corporation
Kelly O'Leary Steel Works
Kelsey-Hayes Wheel Company
Kendrick Manufacturing Company
Kennametal, Inc.
Kensington Steel Company
Kent-Moore Organization, Inc.
Kerk Guild, Inc.
Keuffel & Esser Company
Kewanee Manufacturing Company
Kewaskum Aluminum Company
Kilby Steel Company
Kilgore Manufacturing Company
Kimes, Robert H.
King Machine Tool Company
King-Seeley Corporation
Kingston Products Corporation
Kinsey Company, E. A.
Kohler Company
Koppers Company
Koppy-DeKorse Tool & Die Company
Kraetke Tool Company
Laclede Steel Company
Ladish Drop Forge Company
Lake Erie Engineering Corporation
Lancaster Lens Company
Landers, Frary & Clark
Landis Tool Company
Langdon & Hughes Electric Company
Lansdowne Steel and Iron Company
Lapointe Machine Tool Company
LaSalle Steel Company
LaSalle Tool, Inc.
LeBlond Machine Tool Company, R. K.
Lectrolite Corporation
LeTourneau, Inc., R. G.
Lilly Varnish Company
Lincoln Engineering Company
Link-Belt Company
Liquid Carbonic Corporation
Littleford Brothers, Inc.
Lockwood Manufacturing Company
Long Company, Chas. R., Jr.

(Continued overleaf)

THE ORDNANCE ENDOWMENT HONOR ROLL

(Continued)

Louisville Tool & Die Company
Ludlow Typograph Company
Lufkin Foundry & Machine Company
Mack Manufacturing Corporation
Mackintosh-Hemphill Company
Madison-Kipp Corporation
Magnavox Company
Majestic Tool & Manufacturing Company
Malleable Iron Range Company
Marchant Company, Geo. F.
Mark & Company, Clayton
Marmon-Herrington Company
Marquette Manufacturing Company
Martin, Lemuel H.
Masco Screw Products Company
Maxon Construction Company
May Oil Burner Corporation
McCord Radiator & Manufacturing Company
McLouth Steel Corporation
McQuay, Inc.
McQuay-Norris Manufacturing Company
Mead Screw Products, Inc.
Mechanical Handling Systems, Inc.
Medart Company
Mergenthaler Linotype Company
Mesta Machine Company
Meteor Motor Car Company
Mica Insulator Company
Michael Yundt Company
Michaels Art Bronze Company
Michigan Die Casting Company
Michigan Malleable Iron Company
Michigan Steel Casting Company
Michigan Tool Company
Micromatic Hone Corporation
Midland Machine Corporation
Mid-West Forging & Manufacturing Company
Midwest Piping & Supply Company
Miller Printing Machinery Company
Miller Tool & Manufacturing Company
Mills Novelty Company
Milwaukee Flush Valve Company
Milwaukee Stamping Company
Minneapolis-Honeywell Regulator Company
Minneapolis-Moline Power Implement Company
Modern Die & Drop Forge Company
Modern Retreaders
Moen Sales & Engineering, Clarence H.
Monarch Cap Screw & Manufacturing Company
Monarch Machine Tool Company
Monroe Steel Castings Company
Moore Enameling and Manufacturing Company
Moser & Cotins, Inc.
Mosler Safe Company
Mossberg & Sons, Inc., O. F.
Motor Products Corporation
Motor Wheel Corporation
Motors Metal Manufacturing Company
Mountain State Steel Foundries
Mueller Company
Mullins Manufacturing Corporation
Murchey Machine & Tool Company
Murray Company
Murray Corporation of America
Murray Manufacturing Corporation
Nathan & Sons, A. E.
National Blank Book Company
National Cash Register Company
National Colortype Company
National Enameling and Stamping Company
National Machinery Company
National Postal Meter Company
National Roll & Foundry Company
National Supply Company
National Tube Company
Neville Company
New Britain Machine Company
New Haven Clock Company
New Process Gear Corporation
New York Air Brake Company
Niagara Motors Corporation
Nichols Electric Company
Nicholson File Company
Noble and Company, F. H.
Norma-Hoffmann Bearings Corporation
Northern Engraving & Manufacturing Company
Norton Company
Oatis-Booth Machinery Company
Octigan Forge & Manufacturing Company
Ohio Knife Company
Ohio Steel Foundry Company
Ohlen-Bishop Manufacturing Company
Oilgear Company
Oliver Iron and Steel Corporation
Onan & Sons, D. W.
Ordnance Steel Foundry Company
Otis Elevator Company
Owensboro Forging Company
Owens-Corning Fiberglass Corporation
Owens-Illinois Can Company
Owens-Illinois Glass Company
Packard Manufacturing Corporation
Palmer-Bee Company
Park Chemical Company
Parker Pen Company
Parker Rust Proof Company
Patterson Products, Inc.
Peerless Mold and Machine Division
Perfection Mattress & Spring Company
Perfex Corporation
Pettibone-Mulliken Corporation
Philpott Rubber Company
Pick Manufacturing Company
Pilcher Manufacturing Company, J. V.
Pittsburgh Equitable Meter Company
Pittsburgh Forgings Company
Pittsburgh Plate Glass Company
Pittsburgh Steel Company
Pittsburgh Steel Foundry Corporation
Pletz, Arthur C.
Poor & Company
Porter Company, H. K.
Pratt & Letchworth Company
Pratt & Whitney Division
Pressed Steel Car Company
Procter & Gamble Defense Corporation
Pullman-Standard Car Manufacturing Company
RCA Manufacturing Company
Reed-Prentice Corporation
Remington Arms Company
Remington Rand, Inc.
Reo Motors, Inc.
Republic Drill & Tool Company
Republic Gage Company
Republic Steel Corporation
Revere Copper and Brass, Inc.
Rex Manufacturing Company
Reynolds Metals Company
Rheem Manufacturing Company
Ritchie & Company, W. C.
Robbins Engineering Company
Roberts Brass Manufacturing Company
Roberts Hardware Company
Robinson Laboratories, Louis G.
Rochester Gas & Electric Company
Rock-Ola Manufacturing Corporation
Rockwood Alabama Stone Company
Rodgers Hydraulic, Inc.

THE ORDNANCE ENDOWMENT HONOR ROLL

(Continued)

Romann, John H.
Rome Strip Steel Company
Roth Manufacturing Company
Ruddy, Inc., Bart J.
Ruesch Machine Company, H. J.
Ryniewicz Brothers & Company
Saco-Lowell Shops
St. Louis Car Company
Salem Engineering Company
Savage Arms Corporation
Schauer Machine Company
Schildmeier Company, H. C.
Schmieg Industries
Schoenberger Company, W. J.
Schwitzer-Cummins Company
Seeger Refrigerator Company
Seifreat-Elstad Machinery Company
Selmer, Inc., H. & A.
Seneca Machine Tool Corporation
Seng Company
Shakespeare Products Company
Sharples Chemicals, Inc.
Sheffield Corporation
Sheffield Steel Corporation
Shook Company, H. G.
Siems, Kurt
Slocomb Corporation, F. F.
Smillie and Company, C. M.
Smith Corporation, A. O.
Smith, Inc., Landon P.
Snyder Manufacturing Company, H. P.
Solar-Sturges Manufacturing Company
Sowers Manufacturing Company
Spalding & Brothers, Inc., A. G.
Speed-O-Print Corporation
Spengler-Loomis Manufacturing Company
Sperry Gyroscope Company
Square Stamping Company
Standard Forgings Corporation
Standard Steel Spring Company
Standard Tube Company
Stanley Works
Starline, Inc.
Starrett Company, L. S.
Stearns-Roger Manufacturing Company
Steinhorst & Sons, Inc., Emil
Stephens Company, W. R.
Stewart-Warner Corporation
Stolle Corporation
Strelinger Company, Chas. A.
Strong-Scott Manufacturing Company
Sturges Manufacturing Company
Sundstrand Machine Tool Company
Sunnen Products Company
Superior Steel Corporation
Suprex Gage Company
Swartzbaugh Manufacturing Company
Symington-Gould Corporation
Taft-Peirce Manufacturing Company
Taylor & Fenn Company
Taylor-Wharton Iron and Steel Company
Tennessee Coal, Iron and Railroad Company
Texas Company
Thomas & Skinner Steel Products Company
Thornton Tandem Company
Thresher Varnish Company
Timken-Detroit Axle Company
Timken Roller Bearing Company
Timms Spring Company
Titan Metal Manufacturing Company
Todd Company
Tokheim Oil Tank and Pump Company
Tomkins Johnson Corporation
Tool Steel Gear & Pinion Company
Toro Manufacturing Company
Trailer Company of America
Transue & Williams Steel Forging Corporation
Trico Products Corporation
Tropic-Aire, Inc.
Truck Engineering Company
Truscon Steel Company
Tube Turns, Inc.
Tubular Weaving Company
Twin Disc Clutch Company
Underwood Elliott Fisher Company
Union Carbide and Carbon Corporation
Union Electric Steel Corporation
Union Steel Chest Corporation
Union Spring and Manufacturing Company
United Engineering and Foundry Company
United Forge Company
United Shoe Machinery Corporation
U. S. Automatic Corporation
United States Electrical Tool Company
U. S. Machine Corporation
United States Motor Corporation
United States Rubber Company
Universal Engineering Corporation
Utica Cutlery Company
Utica Drop Forge & Tool Corporation
Utica Steam Engine & Boiler Works
Van Dorn Iron Works Company
Van Norman Machine Tool Company
Victor Electric Products, Inc.
Vilter Manufacturing Company
Vogt Machine Company, Henry
Vulcan Copper & Supply Company
Vultee Aircraft, Inc.
Wade Electric Products Company
Wagner Electric Corporation
Waltham Watch Company
Walworth Company
Ward LaFrance Truck Corporation
Warner & Swasey Company
Warner Electric Brake Manufacturing Company
Waterbury & Sons Company, H.
Waterbury Clock Company
Waukesha Motor Company
Wayne Pump Company
Weatherhead Company
Weaver Manufacturing Company
Wellman Engineering Company
West End Brewing Company
West Steel Casting Company
West Tire Setter Company
Western Cartridge Company
Western Electric Company
Westinghouse Air Brake Company
Westinghouse Electric & Manufacturing Company
Wheeling Steel Corporation
Wheland Company
White Motor Company
Whitin Machine Works
Williams & Company
Williams & Company, J. H.
Williams Oil-O-Matic Heating Corporation
Williams Valve Company, D. T.
Williamson Heater Company
Willys-Overland Motors, Inc.
Woodall Industries, Inc.
Wood-Mosaic Company
Woodstock Typewriter Company
Worcester Pressed Steel Company
Worthington Pump and Machinery Corporation
Wylie, Inc., E. W.
York Safe and Lock Company
Youngstown Sheet and Tube Company
Zenith Optical Company
Zollner Machine Works, Inc.

INVADERS TODAY
...Trucks Tomorrow

Heavy loads, heavy grades, and heavy going mean little to Autocar two-, four-, or six-wheel-drive trucks and tractors. This applies also to the Half-Tracks and other special-purpose vehicles that Autocar is now making for the Army, the Navy, the Marines, and the Air Forces.

AUTOCAR
MANUFACTURED IN ARDMORE, PA.
SERVICED BY
FACTORY BRANCHES FROM COAST TO COAST

FOR EXCELLENCE OF PRODUCTION

Ordnance in Review

THE MACHINE GUN—THE PERIOD OF RECOGNITION, PART IV

LIEUT. COL. CALVIN GODDARD

MENTION has been made in the preceding installment of this series of a Taylor machine gun. The inventor has to his credit some six American patents on such weapons. The first of these, U. S. No. 166,775, is dated July 4, 1871, and covers a multibarrel gun astonishing in its complexity (Fig. 7). The weapon illustrated in the drawings which accompany the patent specifications possesses no less than sixty-one barrels disposed *à la* Gatling and housed in a watertight casing (*J*). On either side of this casing and above the axle of the piece are water tanks (*H*) of considerable capacity, each fitted with a hand pump (*I*) whereby its contents may be forced into the casing for cooling purposes. Abutting the breech of the barrel cluster is a huge fixed metal breech piece (*E*). Around a central shaft which pierces this and lies parallel with and below the barrel casing, revolve four charging plates, arranged in the manner of a 4-leaf clover (Fig. 8). Each of these is pierced with sixty-one chambers, so disposed that all those in any one plate register accurately with the chambers of the sixty-one barrels as that plate is rotated into position at the breech of the weapon.

A huge drum magazine (*L*) located just behind the bottom of the breech (*E*), is likewise pierced with sixty-one cylindrical,

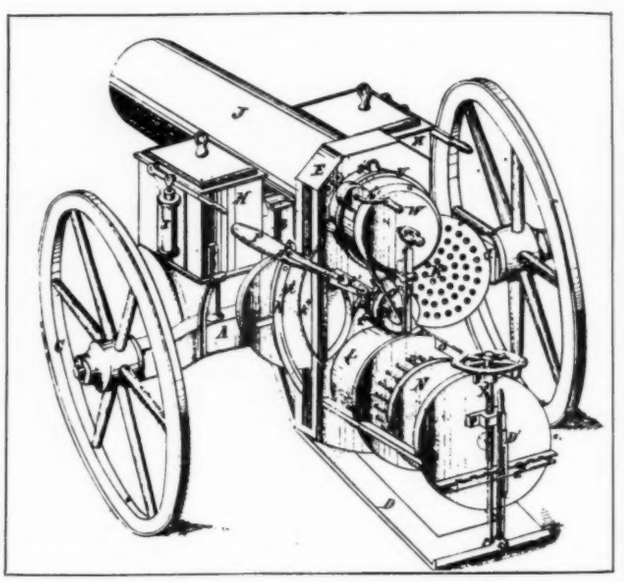


FIG. 7. THE TAYLOR MACHINE GUN, 1871

tubes, each with capacity for ten cartridges. To the rear of this is a pin plate (*N*) carrying sixty-one parallel pins so disposed as to engage the bases of the bottom cartridges in corresponding magazine tubes. A suitable device presses this plate forward each time a new charging plate is brought into position ahead of the magazine. This forward movement advances the pins just sufficiently to deliver the topmost cartridge of each column from the magazine into the chamber awaiting it in the charging plate. Movement of a hand lever (*P*) now rotates the "4-leaf clover," bringing a loaded charging plate into position at the breech of the gun and carrying that plate, the contents of which have just been discharged, through a clockwise arc of ninety degrees during which movement the sixty-one fired cartridge cases it contains are extracted. Simultaneously, the charging

plate last loaded rotates clockwise ninety degrees into a location from which the next movement of the lever will carry it into firing position.

The reader who may be wondering how it would be possible to employ a magazine containing parallel columns of ten cartridges each—the modern military cartridge being about three inches long—may satisfy his curiosity with the knowledge that this piece was designed for the very short rim-fire rifle ammunition of the day. Thus the over-all length of the magazine, instead of being thirty inches or more, need not have been more than half as long.

When Mr. Taylor (who was a resident of Elizabethtown, Tenn.) patented this invention, the impression appears still to have prevailed that it was advisable to disperse in a horizontal plane the fire of any multibarrel machine weapon. (It will be recalled that the Billinghurst and Requa gun provided for such dispersion.) To accomplish this, Taylor arranged to have the outer clusters of barrels in his piece deviate slightly from parallelism with the axes of those forming the inner cluster. He states: "In the present illustration, the barrels are supposed to be arranged at their rear ends in circles, but they diverge forward in horizontal planes to adapt them to cover any desired width of field at a given range or distance. This divergence should not exceed ten degrees in the barrels at the extreme sides of the cluster. This will adapt them to cover a field of 40 or 50 feet in width at a range of 500 yards, the shots of all the barrels being delivered approximately in one horizontal plane." In the gun illustrated, the central barrel cluster comprises six tubes.

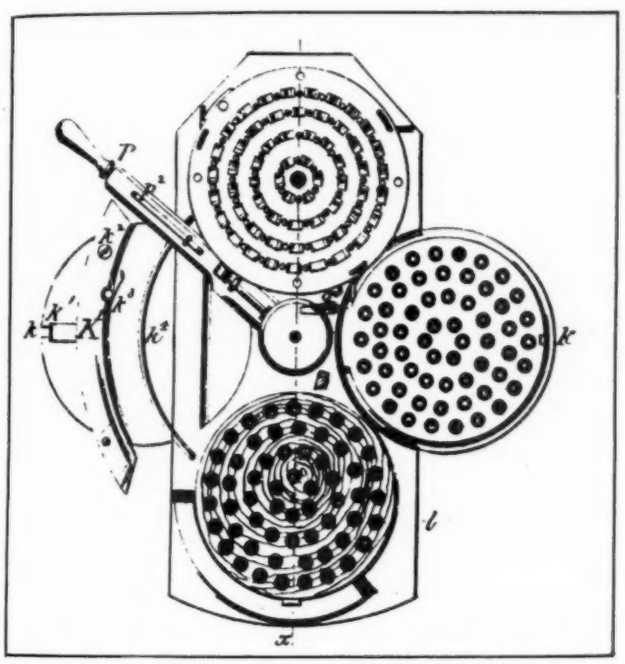


FIG. 8. CHARGING PLATES OF THE TAYLOR GUN

In the one surrounding this we find 13, in the next 18, and in the outermost circle 24—a total of 61.

PROVISION was made to fire all barrels of the Taylor gun either simultaneously or in succession. The capacity of its drum magazine being 610 rounds (10 cartridges in each of its 61 parallel tubes), some ten 61-round volleys could be discharged before magazine replacement became necessary, the ultimate volume of fire being dependent only upon the number of extra magazines it was possible to transport. The whole device constitutes merely an elaboration upon Ripley's patent of October 2, 1861 (No. 33,544) which was described in the first installment of "The Machine Gun—A Period of Evolution" (ARMY ORD-

Bomb with a Nose for News!

NOBODY knows better than you men in the service that when one of these bombs falls, headlines are pretty sure to follow. They literally have a nose for news, because the nose contains the time fuse that sets off the explosion. One of the wartime jobs of Easy Washing Machine Corporation is turning bomb fuses out in quantity . . . and turning them out with a precision that makes certain they won't fail!

Another of our war jobs is helping the men in uniform with their week's wash. No Easy Washers have been built since last May. But many made before then are on duty with the armed forces from Australia to Alaska.

We want you to know that the men and women of Easy are backing you up 100%. Not only by working three full 8-hour shifts a day (with only 20 minutes off for a quick bite) to help keep war materials moving to you . . . but also by investing at least 10% of their wages in War Bonds every week. We know this is the *least* we can do in return for all that you are doing for us! Easy Washing Machine Corp., Syracuse, N. Y.

ORDNANCE TODAY
WASHERS TOMORROW

EASY
America's Leading WASHER

Steelcrete

EXPANDED METAL
Saves STEEL

The Steelcrete system of cold-drawing sheet steel into Expanded Metal produces maximum strength with minimum weight. Steelcrete Expanded Metal is especially adapted for:

Trucks Tanks
Traction and Landing Mats
Plane Parts Tool Boxes
Shell Cases Gratings

The entire facilities of one of our plants, which has been especially designed for the fabrication of light plate, sheet metal or expanded metal products, have been assigned to the production of war items. We solicit your inquiries on either job or production type business.

OTHER Steelcrete SAFETY PRODUCTS

SAFETY GUARDS for Men and Machines
SAFETY GUARDS for Windows, Doors, Conveyors
REINFORCING MESH and WELDED WIRE FABRIC for Concrete

Literature Upon Request
"IT'S WHEELING STEEL"

THE CONSOLIDATED EXPANDED METAL COMPANIES
WHEELING, WEST VIRGINIA
Quick Shipments from 14 Warehouses

NANCE, May-June 1942, Vol. XXII, No. 132, p. 976). For Taylor's gun, like Ripley's, had *fixed* barrels as contrasted with the revolving barrels of Gatling. And, like Ripley's, it provided means for bringing successively into position behind these barrels a number of charging plates, each pierced with a series of chambers which registered with the barrels ahead. True, Ripley made no provision for reloading these plates *in situ* as did Taylor and provided his weapon with much fewer barrels (nine) than did Taylor. But, by the same token, the Taylor gun, if ever actually produced, must have been unconscionably heavy, rival-

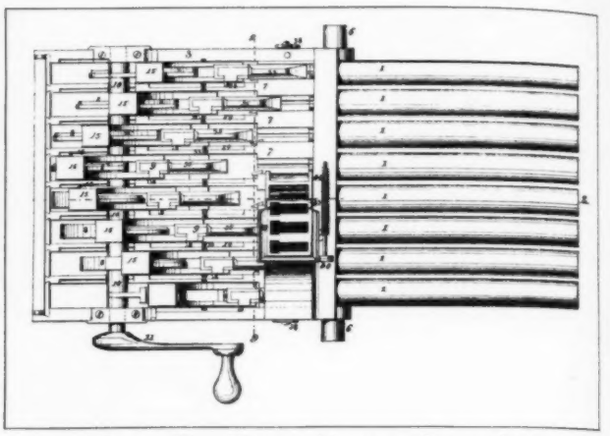


FIG. 9. THE TAYLOR MACHINE GUN, 1876

ing or even exceeding in weight the conventional fieldpieces of the period.

Taylor's next two patents (U. S. Nos. 174,872, and 174,873) were issued on the same day (March 14, 1876), although the applications for these had been filed some months apart. The first "relates to machine guns whether made with one or any number of barrels, having a reciprocating plunger or plungers working, in connection with the barrel or barrels, to introduce the successive cartridges into the firing chamber, withdraw and discharge the empty shell, and permit or cause the delivery from a suitable hopper of a new cartridge . . ." It was especially intended for use with the system of machine guns described in two other applications which he already had on file "in which a series of barrels is mounted either in a horizontal plane or in the arc of a cylinder and . . . made to discharge in succession by revolving cams or a rotating spirally grooved cylinder operating on locks or plungers, one for each barrel."

The chief claims set forth in the specification covered: (1) Oscillating feed valves with fluted concave or beveled upper parts; (2) The combination of a reciprocating lock or plunger and a pair of oscillating valves to receive a cartridge from the feeding device above at one stroke and discharge the empty shell at the next.

This patent, relating as it does only to means for loading, firing, and ejecting, was obviously of less import than its companion, No. 174,873. The specifications embodied in the latter cover "a machine gun (Fig. 10) with a set or series of barrels arranged in the arc of a cylinder, in combination with a revolving cam-cylinder, constructed with two grooves or flanges, one for imparting a longitudinal reciprocating movement to a series of plungers, constituting sliding locks, one for each barrel, and the other groove or flange for retracting the firing pins which are carried by said locks."

Here, we meet for the first time a sheaf of nine parallel stationary barrels arranged in the form of an *arc* rather than a complete circle. This restriction in their disposition was imposed by the system of feed employed, which was of the overhead or gravity type as in the Gardner and Nordenfeldt guns. A new and unusual feature involved provision of an adjustable hopper

Ordnance in Review

front whereby the gun could be adapted to the use of blank ammunition. The drawings which accompany the specifications of Taylor's two patents of March 1876 show that these are designed for center-fire, bottlenecked ammunition.

LESS than two months after being granted these two patents, Taylor acquired another (No. 177,030, May 2, 1876). This relates to a weapon with a number of parallel barrels, horizontally disposed and provided with an overhead gravity feed, each barrel serviced by a separate reciprocating lock mechanism, all in the manner of Gardner and Nordenfeldt (Fig. 9). For it he claims "a new movement for operating the sliding plungers by which the cartridges are introduced into the firing chambers and the empty shells discharged therefrom; . . . a new device for feeding ammunition from the supply hopper into the breech chamber; . . . a new device for supplying ammunition from its packing case or box into the feeding hopper . . ."

The usual operating crank was provided, manual rotation of which caused the "discharge of the barrels in rapid succession . . . no two of them at precisely the same moment."

A new and interesting feature was the construction of "the hopper . . . with diverging throats equal in number to the barrels of the gun. . . . By the use of divergent throats I am enabled to conduct the cartridges from compact cases in which they are packed . . . to any desired number of barrels . . ." Thus the several feed tubes of the hopper fanned out between their upper (loading) ends, and their lower (discharging) ends, simplifying the loading operation and saving space.

A year later (May 8, 1877) came Taylor's next patent (No. 190,645). This embodied several improvements over that of 1876, among the more significant of which was "a peculiar and novel feeding device . . . whereby the cartridges may be fed to the gun directly from the paper boxes in which they are put up

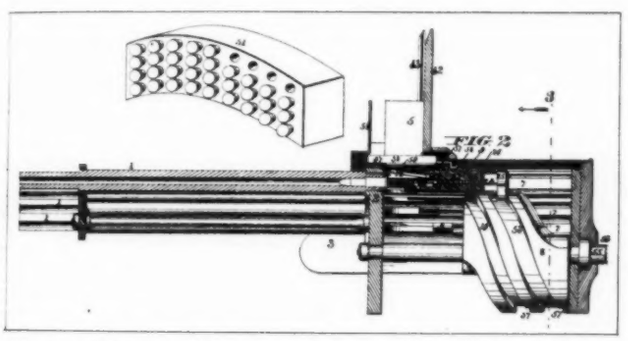


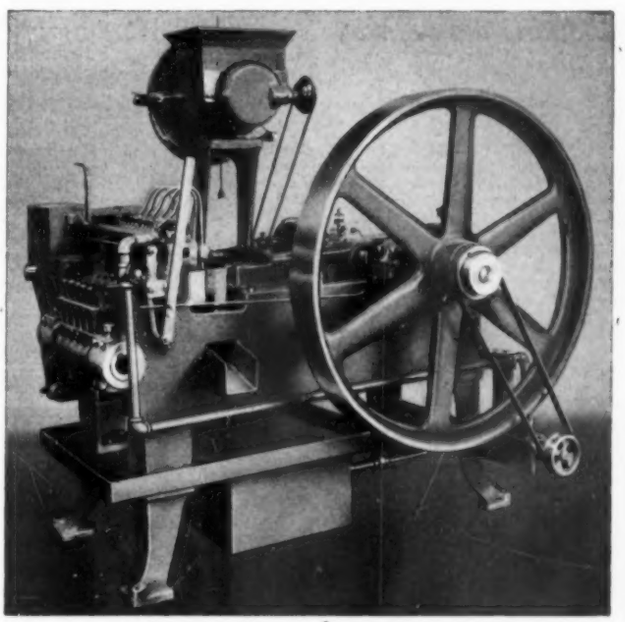
FIG. 10. MACHINE GUN FROM TAYLOR PATENT NO. 174,873

at the cartridge factory for transportation, thus at once avoiding and overcoming one of the essential objections to all machine guns now in use; *viz.*, the handling of the cartridges, one by one, by the gunners before they can be made available to the gun."

With the appearance of his next (and final) patent, however (No. 206,365, July 23, 1878), Taylor's drawings show a relatively straight, center-fire case, but of .50-70 caliber—a type then already obsolete in the U. S. service. This suggests that he may by this time have become interested in the possibility of a domestic outlet for his weapons. But since scrutiny of the index to the Reports of the Chief of Ordnance, 1864-1912, reveals no reference to a Taylor machine gun, it would seem that such aspirations, if they existed, must have come to naught.

Taylor's gun of 1878 was "similar in most of its general features to that described in Letters Patent No. 177,030, granted May 2, 1876 . . ." Study of the specifications shows that numerous improvements have been added, none apparently of vital importance, however. *(To be continued.)*

SMALL ARMS
AMMUNITION
MACHINERY



BULLET-POINTING MACHINE
(Improved Foreign Type)

Five operations available. Companion machine takes cup and preforms all draws, with possible clip trim.

One of our large family of Small Arms Ammunition Machinery. This line is the outgrowth of long experience in the development of machinery for the mass production of bullets, cartridge cases, etc., and the handling of explosives.

While the equipment is used extensively in U. S. Government Arsenals, the line includes also various machinery adapted to the manufacturing practices of England, Canada and other foreign countries.

WATERBURY FARREL
FOUNDRY AND MACHINE COMPANY
Waterbury Connecticut, U. S. A.
SALES OFFICES:
CHICAGO CLEVELAND NEWARK, N. J.

RESULTS OF RESEARCH IN WAR CHEMISTRY

These Practical Products Have Been Developed through Research in Colloidal Chemistry and May Be Found Applicable to Your Business.

Self-Emulsifying Safety Solvent dilutes with water to replace naphtha, gasoline, or benzine for grease-cleaning, hand-wiping operations in metals-processing plants. Contains no chlorinated compounds, has no flash or fire point and does not tend to defat the skin. (Data Sheet # 235)

Hydro-Sealed by floating water blanket, new high-performance Carbon Gum Digestive Solvent cleans carbon and paint from aircraft engine parts without harmful effect. Used hot, water seal prevents escape of solvent vapors. (Data Sheet # 236)

High-Potency Concentrate makes Self-Emulsifying Grease Solvent to remove insulating coats of grease and dirt from truck, jeep, tank, and automobile engines by emulsification and utilizing the heat of a warm engine. Cleaned engines operate more economically since original thermal efficiency is restored. (Data Sheet # 237)

Unique Oil removes salt; may be applied to metal surfaces wet with sea water. Cleans, dehydrates and leaves thin film of rust-preventive compound. Suitable as a cleaner-preservative and lubricant for small-arms bore cleaning. (Data Sheet # 238)

High-Boiling Dehydrating Oil absorbs residual water from parts, storage tanks or equipment. Recovery for repeated use made by simple heating above 212° F. (Data Sheet # 239)

Trichlorethylene Replacement . . . non-volatile cleaning and scouring solvent for large cold immersion tank . . . rinses with hot water. Long solution life. (Data Sheet # 240)

New Fuel Concentrate raises low-test gasoline to high anti-knock rating motor fuel . . . especially applicable for high-compression motorcycle engines . . . increases performance. (Data Sheet # 241)

Sparkling Clear, water-in-oil cooling compound emulsion facilitates work inspections without stopping tools in metal-cutting and grinding operations. (Data Sheet # 242)

Emulsifying Compound cleans oil from camouflage paints; restores dead, flat, lusterless surface. Shipped as a concentrate. (Data Sheet # 243)

Instrument Shampoo emulsifying solvent cleans optical lens and delicate mechanisms without harmful effect. Results in physically clean work and complete absence of any film. (Data Sheet # 244)

Fluid, Pre-Paint Cleaning extracts and emulsifies all traces of wax, oil, and grease from hard surfaces. Rinses with water . . . leaves no film. (Data Sheet # 245)

Carbon Tetrachloride Replacement . . . a methylated aromatic solvent available in open-top lever closures, 5-gallon kits including a steel dipping and drier basket. Designed for mobile unit shop, bench cleaning.

Gunk . . . this versatile base concentrate when diluted with appropriate solvents anticipates every automotive, military, and industrial grease-cleaning problem. (Data Sheet # 248)

Write for Catalogue and Engineering Data Sheets

Confidential formula bulletins will be made available whenever the particular purpose and use that the formula is to serve is described.

Gunk CLEANS CLEAN

FOR CARBON CLEANING—SPECIFY GUNK H-S HYDRO-SEALED CARBON DIGESTIVE SOLVENT ★ IMMEDIATE DELIVERY

5 Gallons or a Tank Car

Mfg. Chemists MALDEN MASS.

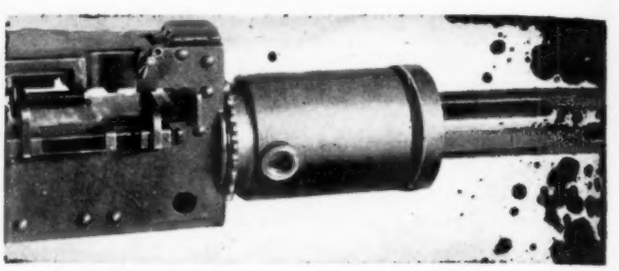
CURRAN CORPORATION

Professional Digest

The Ring-Spring Recoil Adapter

RING-SPRING recoil adapters for machine guns and cannon had their genesis in the draft gears of railroad rolling stock. These draft gears, installed as buffer units at the ends of railroad cars, are initially compressed assemblies in sealed, pressed-steel housings. They weigh some 250 pounds, are about 10 inches in diameter, and have a rated capacity of 26,300 foot-pounds. The functioning of ring-spring recoil-absorption devices has been shrouded in considerable unwarranted mystery, as such units are normally in sealed cases to preserve initial spring compression and to avoid the necessity of field service and periodic maintenance. Actually the operation is quite simple, the recoil energy being largely dissipated in sliding friction between the surfaces of the spring elements.

A ring-spring assembly consists of a number of stacked outer and inner rings, each acting with the adjacent rings along



The Type E-10 Adapter on Caliber .50 Gun

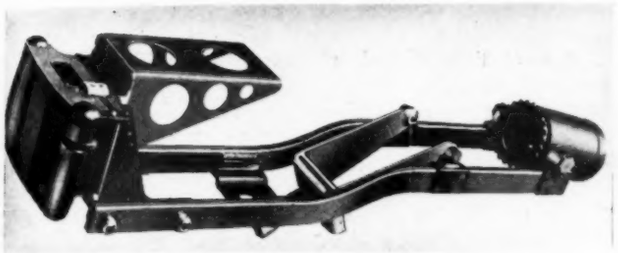
beveled surfaces. The friction between the beveled surfaces increases the force required to produce compression and reduces the force given out on release. When axial force is applied, the rings telescope into each other, the outer rings being subjected to nearly uniform tensile stresses and the inner ones to equally uniform compression stresses. As the outer rings expand and the inner rings compress, they telescope into each other in the direction of the applied force. In operation, it is strikingly similar to the cross-sectional stress conditions in a built-up gun.

Following the practice of World War I, machine guns and cannon were installed in aircraft by means of yokes, mounting pinions, and U-shaped adapter assemblies. As recoil forces were not absorbed along the axis of fire, an unsound couple of forces, contributing to failures, strains, and excessive dispersions, resulted. An improved method of installation, primarily involving means for trunnion mounting and provision for absorption of recoil and counterrecoil forces, became imperative with the initiation of the rearmament program and the increased application of firepower to aircraft. The ring-spring recoil adapter promised a natural solution: first, being concentrically shaped, it would fit conveniently over the barrel jacket directly in front of the receiver, and, secondly, it would uniformly absorb both recoil and counterrecoil forces. Considerable latitude is allowed the designer as the spring characteristics may be varied according to size, material, beveled slope, and even by the use of split rings.

After careful calculation of desired qualities, a number of sample assemblies were subjected to firing tests. These trials developed the interesting fact that the best results, particularly for cyclic rate, are obtained when the natural spring frequency bears a ratio of unity to the gun rate of fire on a rigid mount. In the final design, a compromise of requirements was necessary. For example, a longer recoil distance permits a softer

reaction and greater decrease in recoil forces, but it interferes seriously with the belt feed—disturbing the proper entry of belted ammunition into the feedway. The weight had to be held to the irreducible minimum, and the unit literally had to pay its way by more than a corresponding saving in weight in supporting aircraft structure through decreased trunnion reactions. Field maintenance had to be eliminated and accuracy of fire retained by limitation of dispersion.

THREE basic types of ring-spring recoil adapters have been adopted for the caliber .50 aircraft machine gun. The E-8 adapter, designed for flexible guns, consists of a pair of rectangular-shaped tubes attached at the front to the trunnions of the ring-spring housing and connected at the rear to the back plate assembly which includes the spade grips and single trigger mechanism. A variation of this model, known as the E-12, is identical except for dual trigger controls on the back plate, allowing the gun to be fired with either hand. The adapter, E-10, consists solely of the ring-spring assembly as installed alone on the gun and is employed normally in power-operated gun turrets and fixed installations where the remainder of the



THE TYPE E-8 ADAPTER ON FLEXIBLE GUN MOUNT

gun mount is provided by the turret manufacturer, and by the aircraft company for fixed-gun installations.

The following conclusions are based upon reports from Aberdeen Proving Ground where tests of the adapter were conducted: (1) The unit seems well suited for use as a recoil mechanism. (2) The hysteresis loss is of great importance in that it reduces the counterrecoil forces and tends to reduce stress changes, thereby decreasing metal fatigue and, ultimately, failures in mount or mount supports. (3) By selecting a recoil spring of the proper period, a high rate of fire may be obtained and the forces at the trunnions held within reasonable limits.

From tests of the E-10 adapter, the proving ground determined that the unit limits the recoil and counterrecoil forces to values much less than those experienced with the gun mounted in the fixed position. While variation of the recoil was general, the trunnion reactions were reduced to approximately fifteen per cent of those experienced with the fixed mount. As predicted by the Ballistic Research Laboratory, it was found that the accuracy of the gun when installed in the ring-spring adapter is greater than when in a fixed and rigid mount. The adapter showed no appreciable change during endurance tests and, at a minimum, the serviceable life was considerably in excess of that of the gun.

Four principal manufacturers, each utilizing a considerable number of subcontractors, are engaged in fabricating caliber .50 ring-spring recoil adapters. Ring springs of the larger size are manufactured from specified steel rolled down to bars from which blanks are sheared to make the ring. The small ring springs are machined from tubing on automatic machines in a manner similar to that used in production of small roller-bearing races. After shaping and heat treating they are quenched in oil and placed in a salt bath. Each individual ring is tested for hardness prior to assembling. When the ring springs are staked into an assembly they are subjected to a force-closure inspection test which indicates, in inches, the travel in accordance with applied pressure and graphically plots the release characteristics. The effect of application of an initial compression load is readily apparent.

is KENNAMETAL* *Economical?* Look at The Results of This Test

Operation: Rough turning 155mm. shell

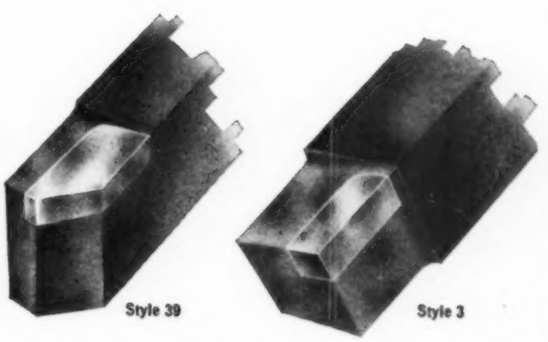
Tool	No. Shells per regrind (average)
KENNAMETAL (Grade KM)	130
KENNAMETAL (Grade KH)	127
KENNAMETAL (Grade K3H)	157
Carbide A	105
Carbide B	85
Carbide C	98
Carbide D	91

Because they remove more metal per regrind and more metal per tool, KENNAMETAL steel-cutting carbide tools are proving themselves the most economical, regardless of price, yet KENNAMETAL prices are substantially the same as the "other carbides" shown above.

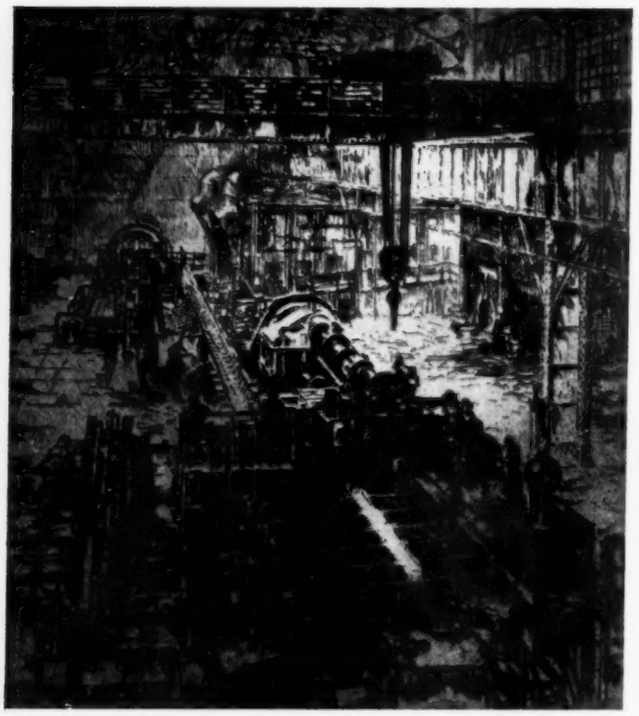
On the same series of tests, KENNAMETAL Grade KM turned more shells during the entire life of the tool than any other tool material tested, in some cases exceeding competition by more than 100%. One set of KENNAMETAL KM tools turned more than 3000 shells during tool life.

KENNAMETAL machines steels of all hardnesses up to 550 Brinell at economical feeds and speeds, thus increasing production and reducing operating costs.

Write for your copy of the new KENNAMETAL Catalog 43B. It contains detailed information and prices on all KENNAMETAL tools and blanks.



KENNAMETAL Inc.
331 Lloyd Ave., Latrobe, Pa.
Trade Mark Reg. U. S. Pat. Off.
Foreign Sales: U. S. STEEL EXPORT CO., 30 Church St., New York (Exclusive of Canada and Great Britain)



Aetna's two great plants are working night and day producing the tools for Victory

ARMY E NAVY

The AETNA-STANDARD ENGINEERING COMPANY

YOUNGSTOWN, OHIO, U.S.A.

ASSOCIATED COMPANIES
HEAD, WRIGHTSON & COMPANY, LIMITED, THORNABY-ON-TEES, ENGLAND
JOHN INGLIS COMPANY, LIMITED, TORONTO, ONTARIO, CANADA

Professional Digest

A similar application of the ring-spring recoil-absorption principle has been developed for the 20-mm. aircraft cannon. It replaces with one compact assembled unit the original French recoil spring and the counterrecoil air dashpot assembly. With respect to recoil distances, the 20-mm. Hispano-Suiza Birkigt aircraft cannon with the M1 (Chatellerault) belt-feed mechanism is very sensitive, and the recoil of 11/16-inch required to operate the feed mechanism must be provided for even the most flexible aircraft mountings. On the other hand, when the French spring is employed, it is necessary to adjust the recoil distances by compression loading of the French recoil spring and the application of shims in order to insure operation of the counterrecoil dashpot assembly. Periodically thereafter, firing tests must be conducted to readjust and shim the assembly, to correct for spring set and other factors such as wearing in of the mount and installation. In the AN-M1 adapter, provisions are made for uniform compression on counterrecoil. The air dashpot counterrecoil assembly suffers from the variations caused by the considerable change in air density between sea level and combat altitudes.

TO meet these difficult requirements, the 20-mm. AN-M1 ring-spring adapter was designed with a soft coil spring to insure sufficient recoil to operate the belt-feed mechanism properly in all installations. In series with the coil spring, the ring-spring assembly picks up compression at a point where the coil spring allows ample recoil for the feed. From that point on, further compression is absorbed by the ring-spring assembly which provides a buffing or snubbing action. Compression beyond the point where interferences with operation will occur is prevented.

In the process of manufacture, each coil spring and each ring-spring assembly is subjected to a force load test similar to that employed for the caliber .50 adapter. Upon final assembly with the recoil-spring unit and application of the initial compression loading, the complete adapter is again subjected to a compression load test and the results recorded graphically as a basis for acceptance.

As a result of extensive tests, the 20-mm. adapter has been accepted as the Army-Navy-British standard. From Aberdeen Proving Ground comes this report: "The 20-mm. ring-spring recoil adapter is the most satisfactory recoil adapter yet devised for the 20-mm., M1 and M2 guns for use with either the M1 magazine or M1 mechanism." The Navy states: "The installation of this adapter is simple and foolproof. There are no adjustments or spring tensions to be made and it is impossible to install it incorrectly. This additionally results in a consistent amount of recoil, insuring more positive action of the feed mechanism or any other feed system actuated by the gun. The performance has been very satisfactory and its operating principle overcomes weaknesses inherent in the original recoil-spring installation." The British say: "Decision was reached to adopt the AN-M1 adapter after extensive tests showed that, with the ring-spring recoil adapter fitted to the gun, the gun recoil was very consistent and quite adequate to operate the feed mechanism. The actual recoil loads were also greatly reduced, especially during the 'run-out' stroke." These opinions, from such authoritative sources, constitute a strong endorsement of the adapter.

Probably by coincidence, the new German MG151 Mauser aircraft gun incorporates a ring-spring recoil-absorption device. The resilient mounting employed in the German 151 guns of 15-mm. and 20-mm. caliber includes a cylinder which serves as a housing for the ring-spring assembly. Each assembly consists of a number of rings interfitted and arranged so that they are subjected to a load. One outer ring is split and has a fitted lining which contacts the inner walls of the housing and functions as a friction brake.

Professional Digest

THE SPERRY AUTOMATIC SIGHT

THE Sperry automatic computing sight has helped make the B-17 Flying Fortress bomber the deadliest heavyweight fighter of the war. The sight, an integral part of the Sperry-designed upper local and lower ball turrets, makes the caliber .50 machine guns effective at ranges up to 1,000 yards. Compared with the accurate ranges of enemy pursuit airplanes, this gives U. S. gunners a decided advantage that enables them to destroy Axis attackers before they can get close enough to deal telling blows.

The computing sight automatically figures the "fall" of the bullet because of gravity, the ballistic deflection caused by wind, and the amount of "lead" required to hit a target. Duck hunters

THE COMPUTING SIGHT USED WITH TOP TURRET GUNS

realize that to hit a moving bird, the gunner cannot sight directly on the target. If he does, the bird will be out of the line of fire by the time the shot reaches its intended objective.

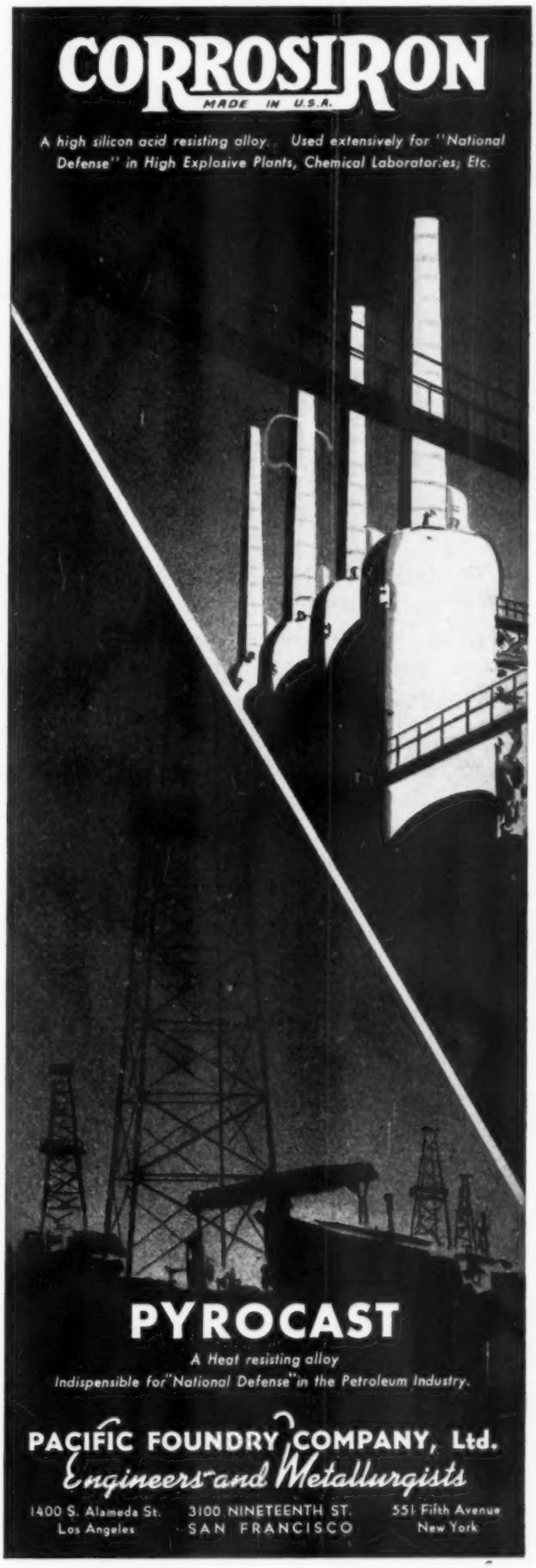
Shooting from a fast-moving bomber at a faster-moving target makes the problem more involved. Even though the muzzle velocity of caliber .50 shells is 2,700 feet a second, the correct computation of lead, fall, and deflection is the essential ingredient of successful aërial gunnery.

As far as the gunner is concerned, when using the automatic device, he *seems* to aim directly at the target. The sight, however, points the guns automatically and continuously at the spot where the target will be by the time the bullets arrive. The gunner makes no mental calculations. Trained to recognize the various types of enemy pursuit planes, he has only to adjust the sight control to correspond to the dimensions of the attacker. If, for instance, the attacker has a wingspread of forty feet, the operator twists the knobs to "40" on the dial, much like tuning a home radio (see illustration above and on page 342).

Peering through the reflecting glass atop the sight, he must get two illuminated vertical lines on the target—a line at the outermost tip of each wing. This he does by controlling the movement of the turret and by operating a foot treadle which spreads the verticals to keep them on the wing tips as the pursuit plane, moving at terrific speed, roars closer, thus automatically and continuously setting the proper range.

BODY ARMOR FOR BOMBER CREWS

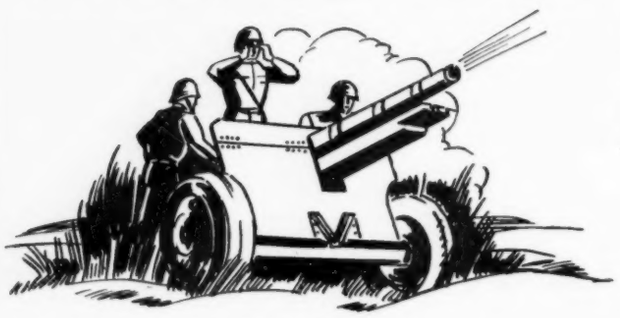
BODY armor to sheath the wearer from neck to hips has been developed by the United States Army's Eighth Air Force in England to protect members of bomber crews from missiles of relatively low velocity, which have been found to cause the vast majority of wounds. The protective covering was devised by Col. Malcolm Grow, surgeon of the Eighth Air Force, whose


CORROSIRON
MADE IN U.S.A.
A high silicon acid resisting alloy. Used extensively for "National Defense" in High Explosive Plants, Chemical Laboratories, Etc.
PYROCAST
A Heat resisting alloy
Indispensible for "National Defense" in the Petroleum Industry.
PACIFIC FOUNDRY COMPANY, Ltd.
Engineers and Metallurgists
1400 S. Alameda St. Los Angeles
3100 NINETEENTH ST. SAN FRANCISCO
551 Fifth Avenue New York

PERMITE

QUICK-DRYING

SPECIFICATION FINISHES



Help Speed Ammunition to the Battle Fronts!

AMMUNITION manufacturers avoid delays for cooling or drying, by using Permite Government Specification Lustreless Ammunition Lacquer Enamels.

Permite Ammunition Lacquer Enamels can be sprayed upon the shot, shell, bomb or hand grenade immediately following the hot alkali bath. No blistering, no cracking.

Permite Lacquer Enamels reduce to about two minutes the drying time required for handling after application to the hot shells or other ammunition. This further saving in time is reflected in speedier production.

Furthermore, there is a saving in cost of materials, as Permite Lacquer Enamels give extra coverage per gallon.

Our technical staff is at your service in formulating Permite Government Specification Finishes for ammunition or other war materials.

Quotations and technical information submitted promptly upon request.

ALUMINUM INDUSTRIES, Inc.
Cincinnati, Ohio

PERMITE *Industrial* ***FINISHES***

Professional Digest

research determined that a thin steel plate would stop low-velocity missiles, such as flak.

The armor weighs twenty pounds. Its base is a sleeveless canvas slip-on with transverse pockets into which plates of steel are slipped. It consists of front and rear covers suspended from the shoulders and laced together along the sides. The garment can be removed instantly by pulling a release cord threaded through eyes joining the two sections along the shoulders.

The body armor has been found to be particularly effective for waist and turret gunners, who expose the upper parts of their bodies.

THE NEW BAYONET

AMERICAN combat units on all battle fronts are now being supplied with a shorter, lighter, and sturdier bayonet by the Ordnance Department. Strategic materials saved through development of the new bayonet total 362 tons of high-carbon steel from estimated 1943 production and 560 tons from the forecast of 1944 production.

THE OLD BAYONET (LEFT) AND THE NEW BLADE (RIGHT)

The blade of the bayonet has been shortened from sixteen to ten inches, its weight reduced considerably, and its battle use improved. The new bayonet, like the old one, is flat or sword-like in appearance. It may be used as a trench knife, is easy to handle, and has been especially welcomed by jungle fighters, paratroops, and air-borne infantry.

NEW GERMAN ANTITANK GUN

PROBABLY the most powerful enemy antitank gun yet developed is the new German 75-mm. Pak 41 which made its appearance for the first time in Tunisia. It is built on the tapered-bore principle and, according to the *Military Review,* fires an armor-piercing projectile weighing 5.7 pounds at an initial velocity of 1,000 feet a second.

Preventive Maintenance

PART V: SUPERVISION IN THE FIELD

COL. T. L. PREBLE

PRECEDING articles in this series have been concerned, primarily, with the vehicle driver and the organizational mechanic. They are the literal "caretakers" of the Army's wheeled and tracked equipment. The success or failure of all preventive maintenance is directly in their hands.

But those hands, however skilled, must be guided and strengthened by vigorous supervision in the field. Vehicle maintenance is a function of command. The ultimate responsibility for preventive maintenance rests with the officers, commissioned and noncommissioned, who organize and enforce it. "The success of preventive maintenance within a regiment or similar unit," says Field Manual 25-10, "depends upon the judgment, energy, ability, and common sense, not only of the commander, but also of all subordinates." In combat zones, where peak mobility must be maintained without benefit of hard-and-fast rules, such qualities are extremely essential.

The basic prerequisite is an efficient organization—within each organization—made up of personnel best qualified to uphold the Army's preventive-maintenance standards. The selection of each man—from the regimental motor officer to the individual driver of a ¼-ton truck—is an important decision. Qualifications in terms of background and ability must be weighed with considerable care. Training, discipline, and morale must be maintained at a high level if the organization is to be fully and steadily effective.

In order to insure a high degree of efficiency for vehicle maintenance, commanding officers should put into effect the following policies:

1. Separate as much as possible the vehicle operation and maintenance functions within the second echelon. This is desirable because responsibilities are more likely to be carried out when they are clearly defined. Even when separated, however, operation and maintenance should be coördinated as much as possible.

2. Enforce regulations pertaining to preventive maintenance. Frequent checking by regimental or battalion commanders will reveal any weak spots in the maintenance program so that constructive action may be taken.

3. Make provision for, and conduct programs to insure, proper and standardized training of personnel, including drivers and mechanics.

4. Record the maintenance services, dead-line periods, and any other desired data (such as lubrications) on a vehicle duty roster, as prescribed by Army Regulations 850-15, Change 3. The fact that such a record is kept should be announced to all concerned. If used properly, a data-recording system will give the organization commander a constant cross section of the maintenance situation in his command.

5. Obtain authorized forms for routine lubrication, maintenance inspection, and scheduled preventive-maintenance services on all types of assigned motor vehicles. These forms, both mandatory and optional, are specified in Change 3 to Army Regulations 850-15.

6. Make the command inspections necessary to insure proper coördination and functioning of all personnel.

As the commander's principal representative, the regimental or battalion motor officer directs his energies toward a single pur-

Colonel Preble is chief of the Preventive Maintenance Section of the Ordnance Department Tank-Automotive Center, Detroit, Mich.

His Wings Are Clipped But He'll Fly Again

Thirty seconds to leave a sinking plane . . . the first thought of the bomber crew is for the boats of rubberized canvas duck.

This tough, durable fabric is saving thousands of lives . . . enabling men to fly again.

Each plane is equipped with boats that are strong enough to protect both crew and provisions, and are still light enough when deflated to be easily stored aboard planes.

Duck was long a bottleneck in the production of textiles for war. But America's great mills have succeeded in stepping up production to meet today's increased demands.

Butterworth Machines play their part in the battle of production at every step in the wet end of textile finishing—bleaching, boiling-out, drying, calendering, dyeing.

The coöperation of Butterworth Engineers is freely offered to every mill seeking to achieve increased productive efficiency . . . or to repair or replace worn-out or obsolete equipment.

All of our facilities not required for Ordnance production are available to help you solve your problems. Let us serve you now.

H. W. BUTTERWORTH & SONS COMPANY
Phila. 25, Pa. Serving the Textile Industry since 1820.
Offices in Providence, R. I., and Charlotte, N. C.
In Canada: W. J. Westaway Co., Hamilton, Ont.

Butterworth
PRODUCING GUN MOUNTS FOR THE UNITED STATES ARMY

WOODEN BARRELS
NOW MADE TO DO THE JOB
OF METAL

by Using

3-M ADHESIVES

and 3-M COATING COMPOUNDS

This is just one of a number of today's problems solved by 3-M Adhesive engineers.

There are more than 100 adhesive coating and impregnating fluids, sealants and sprayon insulators in the 3-M Adhesive Line made from reclaimed rubber, synthetic rubber, synthetic resins and non-rubber materials.

Have you a problem that the use of these products might solve? A word from you and one of our experienced Adhesive engineers will gladly review your problem—without obligation, of course.

MINNESOTA MINING & MFG. CO.

Saint Paul, Minnesota,

Adhesive Division—Detroit, Michigan

Gentlemen: AO 943

Kindly have one of your 3-M Adhesive Engineers call and review our production problem.

Name.....

Department.....

Company.....

Address.....

City.....Zone.....State.....

★ ★ ★ ★ ★

3-M PRODUCTS AIDING WAR PRODUCTION

ABRASIVE PAPER and CLOTH PRODUCTS
"SCOTCH" TAPES
ADHESIVES
WAX and SEALER
LAPPING and GRINDING COMPOUND
CUTTING and FINISHING COMPOUND
FIBRE PACKING
"SCOTCHLITE"

Preventive Maintenance

pose—to keep the greatest possible vehicle strength ready at all times for immediate operation. To achieve this goal, he must fulfill many functions. He is a consultant, supervisor, technical administrator, teacher, and inspector for all the units in his regiment or battalion. A good motor officer is soon known by the small number of his vehicles that remain on the dead line.

As a consultant, the motor officer helps the organization commander to prepare bulletins or training directives to be issued to subordinate units. He advises the commander of the vehicle strength and of the quality of technical personnel in the organization. He should be able to inform the commander of the general condition of the maintenance organization at any time and be able to offer constructive criticism.

As a supervisor, the motor officer is constantly watchful for the opportunity to improve the standard of preventive maintenance in the organization. He assists subordinate unit commanders and their officers in overcoming maintenance problems. He checks informally on the quality of preventive-maintenance work by calling, without prior notice, for specific vehicles of the regiment. When schools are conducted for the purpose of training drivers, mechanics, or other maintenance personnel, the motor officer supervises the quality of instruction and the material being taught. Under special conditions, the motor officer will supervise repair operations and unit replacement as may be authorized. His supervision is never completed. He is constantly striving to improve the entire going program of vehicle operation and maintenance.

As a technical administrator, the motor officer again has multiple duties. He checks the vehicle operation and maintenance records and reports of the various units, seeing to it that they are kept in an efficient and orderly manner. From these records he prepares and forwards reports on maintenance activities to higher headquarters. The motor officer also consolidates requests for third-echelon work and requisitions for automotive supplies. While inspecting subordinate unit shops, he is watchful for any hoarding of parts which would interfere with the efficiency of his maintenance organization. The motor officer keeps all subordinate units informed as to the location of regimental or battalion repair facilities in the field. He also makes certain that preventive-maintenance work sheets, lubrication guides, and all other maintenance aids and directives reach the hands of the men who need them and that every vehicle is equipped with its proper manual.

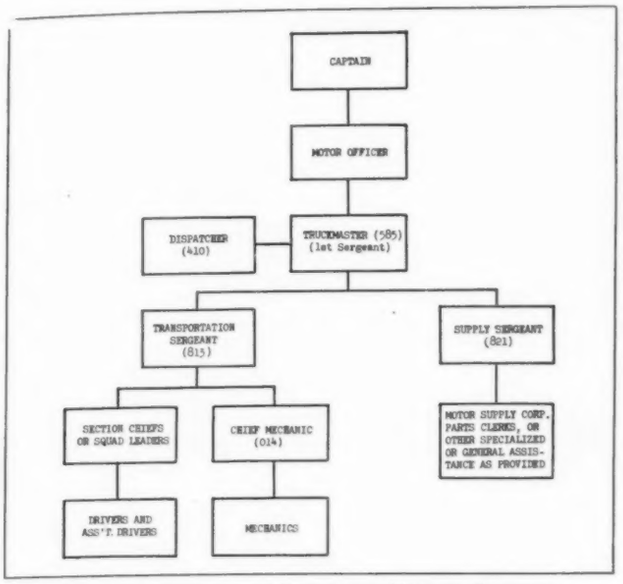
As a teacher, the regimental or battalion motor officer conducts organized group instruction for key automotive personnel of the regiment. Such instruction, given as needed, includes preventive maintenance as a major subject. As an inspector, the motor officer inspects preventive-maintenance operations at frequent intervals to enforce the required standards of work. He keeps a close watch on lubrication practices and on the storing of fuels and lubricants.

The organization of automotive-maintenance personnel in each company (or similar unit) will vary according to the Tables of Organization. However, there are four basic types of organizational structure among the companies of a typical division, as follows: (1) A company whose predominant function is other than that of providing transportation or maintenance for other organizations—for example, a Signal company or Cavalry reconnaissance troop; (2) A company whose predominant function is to provide transportation for other organizations—for example, a Quartermaster truck company (see chart); (3) A company which provides regimental or battalion maintenance—for example, a service battery of a Field Artillery battalion; (4) A company whose predominant function is to provide maintenance for other organizations—for example, an Ordnance light-maintenance company.

In each instance, the company commander is responsible

Preventive Maintenance

at all times to higher commanding officers for maintenance activities within his organization. It is one of his administrative functions to enforce the standards of preventive maintenance as stated in directives from higher echelons of command. In the absence of such directives, the company commander should base his standards on those set forth in AR 850-15. By making frequent command inspections and conferring with the company



ORGANIZATION OF A COMPANY WHICH PROVIDES TRANSPORTATION FOR OTHER UNITS

motor officer (if one is provided) or with the motor sergeant, the company commander should ascertain whether his personnel are well schooled in preventive maintenance and whether they fully understand their responsibilities. If he finds that they need training, he should take steps to provide it. The commander should bear in mind that training in the proper care of equipment is, like tactical training, a definite essential.

The company (or similar unit) motor officer's position is one of the utmost importance. Through constant supervision and initiative, he can prevent many mechanical failures which might eventually contribute to a breakdown in the whole maintenance system. The standard of work accepted by the company motor officer will be reflected in the number of vehicles that have to be sent to higher echelons for repairs. He must know the required standards of vehicle condition, know the vehicles themselves, and know his maintenance personnel. Like the regimental or battalion motor officer, he has other vital duties in connection with training, inspections, records, and reports.

Further supervision and enforcement of preventive maintenance are provided by the motor sergeant, often acting as both truckmaster and chief mechanic. If he is properly trained and has a clear understanding of the need for preventive maintenance, he can do much toward establishing a high standard of vehicle reliability for the organization. Other noncommissioned officers vital to preventive-maintenance supervision are the chiefs of section and squad leaders.

Take this whole active team of supervisory personnel; add thoroughly trained drivers and mechanics; add high-quality vehicles, tools, and supplies; add officially standardized manuals, work sheets, lubrication guides, and other "how-to-do-it" publications—and you have a preventive-maintenance program that can do much to hasten our victory in this mechanized war. (*Part VI will discuss the training program for officers, drivers, and mechanics.*)

IN the production of brass and aluminum fuses the reduction of "down time" to the least possible degree is all important!

Cutting operations on multi-spindle automatics, such as reaming, eccentric drilling, tapping and threading, respond to the application of Stuarts "Super-Kool" No. 151 Brass Cutting Oil, or Stuarts "Super-Kool" No. 1M Aluminum Cutting Oil frequently with a surprising improvement in tool life and finish.

For all cutting fluid problems
D. A. STUART OIL CO.
LIMITED
Chicago, U.S.A. • Est. 1865
Warehouses in All Principal Metal Working Centers

IF CHAIRS WORE SERVICE STRIPES

It takes a lot of chairs to serve Uncle Sam's Army and if service stripes were passed out for them, Sheboygan Chair Company Chairs would rate high honors. On every front, at home and overseas, our chairs are doing 24-hour duty in mess halls, barracks, officers' quarters, recreation centers, training schools.

Chairs of many different types are required and their chief qualification must be ruggedness, because, as you know, fighting men don't "baby" chairs. Sheboygan Chairs are noted for their sturdy qualities, but they are also well engineered for balance and comfort.

Sheboygan Chair Company began building chairs in 1868. Our diamond trade-mark is a veteran of four United States wars, and appropriately symbolizes our 75th Anniversary.

SHEBOYGAN CHAIR COMPANY

Good Chairs Since 1868—for military use, homes, offices, schools and institutions

SHEBOYGAN, WISCONSIN

OUR 75th ANNIVERSARY AS CHAIR CRAFTSMEN

Book Reviews

FIELD ARTILLERY—BASIC. Harrisburg: The Military Service Publishing Company. $5.

THIS large book combines two volumes of basic field-artillery information within one cover. There is a separate index with tabs for each volume, supplemented with an appendix. An envelope containing a special map and protractors is included to be used in conjunction with problems in the texts. In addition to the subjects pertaining strictly to field artillery there are several chapters of general military interest. Following each chapter is a list of questions, the answers to which may be found in the appendix. The subject matter is very similar to that appearing in the R.O.T.C. field-artillery textbooks, also printed by the Military Service Publishing Company.

Weapons covered are the caliber .50 machine gun, 37-mm. antitank gun, 75-mm. gun, 75-mm. howitzer, 105-mm. howitzer, 155-mm. gun, and the 155-mm. howitzer. Discussions include the service and firing of the piece and the care and maintenance of matériel. Elementary principles of ballistics and gunnery are thoroughly covered for the beginner. Instruction in the use, care, and adjustment of the following fire-control instruments is afforded: aiming circles, battery-commander telescopes, range finders, field glasses, compasses, and nonoptical instruments. The remaining subjects on field artillery include duties of the battery-commander detail, battery communications, the care and operation of motor vehicles, and the history and development of artillery.

The following general military subjects are also presented: military courtesy and discipline, military sanitation and first aid, military organization, leadership, map reading, physical training, dismounted drill, ceremonies, interior guard duty, individual equipment, and tent pitching, care of animals and stable management, and equitation.

Although publication date of the book was May 1, 1943, several of the topics are already in need of revision. Service Commands are referred to as Corps Areas, and the Army Service Forces are called the Services of Supply. Under the Army Service Forces mention of the Transportation Corps has been omitted. While listing functions of the service branches it is erroneously stated that the Quartermaster Corps is charged with third- and fourth-echelon maintenance of motor vehicles. These duties were transferred to the Ordnance Department in August 1942.

An excellent chapter on the United States and World War II is carried as a part of the introduction. This lists the events leading up to the war and discusses the relations with Japan, the text of proposals made by the United States, and a statement of Japan's rejection of these proposals.

"Field Artillery—Basic" has been edited and presented in the usual excellent manner characteristic of the texts printed by the Military Service Publishing Company. The student of field artillery will find the answers to his questions in this book.

B. B. A.

DEFENSE. By Field Marshal General Wilhelm von Leeb. Harrisburg: The Military Service Publishing Company. $1.

THE author of this treatise on active defense is one of Germany's outstanding authorities on the subject. It is a book which should be in the hands of all officers interested in what Von Leeb has to say about strategy and tactics.

The text is divided into three parts: first, "Operative Defense in a War of Movement: Inner Line Operations and General War Plan"; secondly, "Defensive Conceptions, German School, be-

tween Wars; Present Defensive Tactics, New Weapons, and Means"; and thirdly, "Strategic and Tactical Defense, World War II: The Culminating Point of World War II in Europe."

Each phase is pictured with incidents which describe Von Leeb's theories. He presented Hitler with a carefully worked out plan for the war against Russia—a plan which in its entire concept was diametrically opposed to the German war plan of 1941. However, according to Max Werner, in "The Great Offensive," Hitler rejected this plan, but the lessons had been well learned by Russia to the extent that the Red Army was able to stop the German *Blitzkrieg* as was demonstrated at Leningrad, Moscow, Sevastopol, and Stalingrad.

This book is probably the most important piece of research in the field of strategy and tactics in modern warfare that has appeared in the past decade. F. H. W.

QUEENS DIE PROUDLY. By W. L. White. New York: Harcourt, Brace and Company. 273 pp. $2.50.

THE author of "They Were Expendable" has written an account of the U. S. Army Air Forces during the first months of the war which matches his earlier success for action and interest. The action evolves around the experiences of the former Olympic swimmer, Lieut. Col. Frank Kurtz, and other personnel of the 19th and 7th Bombardment Groups.

A few weeks before December 7, 1941, the pilots at Clark Field, Philippine Islands, felt that war was imminent and that when it came they would be in a dangerous spot because of the field's proximity to Japanese air bases. When announcement came through that Pearl Harbor had been attacked, the Commanding General of the Far Eastern Air Forces knew that Formosa should be bombed at once but was prevented from carrying out such a plan because Congress had not yet declared war on Japan. The intervening hours brought an onslaught of the Japanese from the air which largely immobilized the U. S. Air Forces in the Philippines and precluded any chance of an American bombardment of Japanese bases in their own territory.

In spite of the appalling damage suffered by our forces during those first few days, the remnants of the Air Corps carried on from the Philippines as long as their bases were tenable and then fought southward from island to island until Java had been reached. During all these operations, flights were made without fighter escorts and from fields unprotected by antiaircraft guns and fighter planes.

From Java, a brave stand was made against overwhelming odds, always with the hope that adequate air reënforcements, which did not materialize, were on the way. Here the bombardment group received fighter support in some measure from a few Army and Navy pursuit planes and the Dutch Air Force. The latter group made up for its small size and obsolescent planes by skill and courage. Hardly a day passed that damage was not inflicted on the enemy, but always at the high cost of the loss of American planes and crews. A constant loss of planes was caused by the incessant bombing and strafing of American airdromes by the Japanese. Operations continued from Java until a few hours before the island fell to the Japs. At the last minute, all planes that were in condition to make the trip, together with Air Forces personnel for whom there was space, were evacuated to Australia. While on Java, repair of the planes was carried out by the air crews, including the pilots. Due to the fact that the bombs used were Dutch, it was necessary to modify them in order to load the bomb bays.

So absorbing is the story that it is difficult for the reader to tear himself away from the book once it is started. Written in the informal style characteristic of Mr. White, the narrative is related in the words of the figures around whom the book is written. To the many people who wondered why our troops on Bataan did not receive adequate air support, the reason is revealed in this story. It spans the reverses of the first six months and then describes how the power of our Air Forces grew until

Khaki towns—temporary homes for the boys of our armed forces during their training periods—have been built from coast to coast. In many instances these towns seem to have been built overnight.

The important preliminaries of clearing and grading the sites for many of these encampments have been done by Cletracs with supplementary equipment, such as the Sargent loader illustrated above. Bulldozing, hauling, tree felling, earth moving, road building—whatever the job, no matter how tough—you'll find Cletracs more than adequate.

GASOLINE Cletrac OR DIESEL
Crawler Tractors

THE CLEVELAND TRACTOR COMPANY
CLEVELAND, OHIO

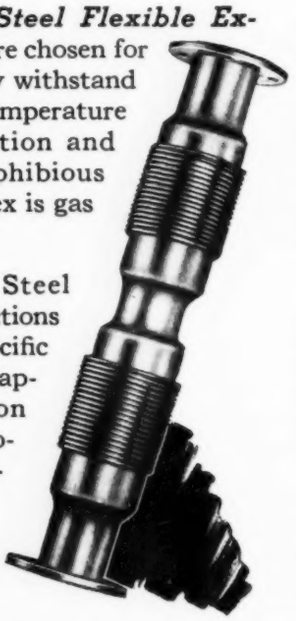
REX-FLEX

Helps Put 'em Ashore

Acme Photos

SHOCK troops ashore—armor into action—another beachhead won! Through drenching combers, hurtling onto beaches—each part, each vital assembly in America's landing boats, tanks and other combat vehicles must stand up and take it.

Rex-Flex Stainless Steel Flexible Exhaust Connections were chosen for this service because they withstand the hot gases, violent temperature changes, severe vibration and landing shocks of amphibious operations, *and* Rex-Flex is gas and water-tight.



Rex-Flex Stainless Steel Flexible Exhaust Connections are designed to meet specific requirements. Their adaptability for installation helps to speed up production of the vital machines of war.

Ask for Engineering Recommendations

CHICAGO METAL HOSE CORPORATION

General Offices: MAYWOOD, ILLINOIS

Factories: Maywood and Elgin, Ill.

Book Reviews

sufficient strength was reached to take the offensive and roll the Japs back toward their ultimate defeat. It shows the superiority of our pilots in flying skill over the Japanese airmen. The book ends when Lieutenant Colonel Kurtz returns to the United States as pilot of the famous Flying Fortress, "The Swoose," the only plane of the original group on Clark Field to survive the fighting and get back. It is recommended that every citizen of the United States read "Queens Die Proudly." B. B. A.

SERGEANT TERRY BULL: HIS IDEA ON WAR AND FIGHTING IN GENERAL. By Terry Bull. Washington: The Infantry Journal. 174 pp. 25¢.

THIS is one of the Penguin Books published by the *Infantry Journal*. Col. William H. Triplet, U. S. Army, is the author of the "Terry Bull" stories, many of which were written as far back as 1939. All the narration is in the first person as told by Terry Bull or his brother Horatius Bull. Thus, military tactics and the use of weapons is made interesting by using the language of the ordinary soldier instead of the stilted style of the textbook. Most of the action, all fictitious, takes place during an imaginary war of the future. Ideas for several new weapons are presented, as well as suggested modifications for numerous weapons already in use by the Army. An interesting plan is presented for conducting combat firing in defense and attack problems. Throughout the book, use of such weapons as the bayonet and trench knife is discredited.

By far the most interesting portion of the book is a long narration entitled "The Second Platoon" which tells of an attack actually made by the 140th Infantry, 35th Division, in France during World War I. The errors and confusion found in battle are vividly portrayed, and the style is so realistic that the reader feels that he is actually present at the scene of battle. Those who have already taken part in combat will immediately recognize some of the situations in which they found themselves, while others will learn what to expect in forthcoming battles. B. B. A.

SUYE MURA—A JAPANESE VILLAGE. By John F. Embree. Chicago: University of Chicago Press. 354 pp. $3.

THE author, assistant professor of anthropology at the University of Hawaii, presents a social study of a Japanese village, showing the life and customs of the lower classes of Japanese. (This is a companion volume rounding out the study of the upper classes given in "In Peace Japan Breeds War," by Gustav Eckstein.) The part which sex, religion, exchange of labor, coöperation and government paternalism play in their individual and family lives is described in great detail. Japanese words, fully explained, are used throughout, and add to the interest of the text.

The establishment of schools and conscription, the change from a rice economy to a money economy, the coming of the machine age to Japan, all change the habits but not the philosophy and basic beliefs of the individuals. These are truly a people steeped in centuries of custom and habit. They are not easily influenced and their blind adherence to government edict and ancestral belief makes them a difficult enemy. Any change in their behavior or action will be surprising. T. K. V.

IN PEACE JAPAN BREEDS WAR. By Gustav Eckstein. New York: Harper & Brothers. 326 pp. $2.50.

THE Japanese have hated the United States from the time Commodore Perry entered Yedo Bay in 1853: "The moment when the first white man, Capt. Franklin Buchanan, stepped from the landing onto the sand, a visible and audible and ominous excitement ran through the watchers. Japanese soil, sacred Japanese soil, had been defiled, and that this feeling was no mere literary invention the ninety years since have amply shown. The revenge there sworn has been renewed again and again."

The author arrived in Japan on the day the American Exclusion

Book Reviews

Act went into effect—July 1, 1924. This was deemed an added insult to Japan and in their minds could be wiped out only by war. From that date, preparation started in earnest for what turned out to be Pearl Harbor and the start of the present war. The author made many trips to Japan, living with the people—usually the upper and middle classes. He pictures the people of these classes as well fitted for warfare, unmoved in the face of death. A very strong family life and unswerving obligations to their dead and to their Emperor make a different civilization which the West will never understand. Jujitsu—"destruction of the opponent through his own strength"—symbolizes Japan's philosophy of war.

This book is fascinating and most enlightening regarding the lesser known facts about our almost unknown adversary. Every American who is thinking of the war in the Pacific should read this book to gain an understanding of these people. The form of the peace to be established after the war is over as well as the type of government to be given to them is fully discussed, taking into account the capacity of the Japanese to absorb new ideas and the nature of the individuals themselves. T. K. V.

WHAT TO DO ABOARD A TRANSPORT. By a group of scientists. Washington: *The Infantry Journal*. 260 pp. 25¢.

ANOTHER in the Fighting Forces Series is this interesting and informative pocket-size book prepared by several scientific writers under the guidance of the Boston-Cambridge Branch of the American Association of Scientific Workers. This group, as well as the illustrators, has presented the book as a nonprofit activity in the interest of popularizing science.

The book's eleven chapters discuss subjects designed to arouse the interest of the seafaring traveler in the things he sees all around him on his journey. In addition to an explanation of the construction and operation of ships in general, there is a section devoted to navigation which presents the subject in a manner easily understood by persons without previous knowledge of such matters. This is supplemented with discussions on time, the stars, weather, and islands. There are several pages descriptive of sea life and oceanic birds. The final chapter tells how to keep well aboard ship.

A book of this type opens a new world of interest to those on a transport who might otherwise see nothing but waste expanses. Those who have already journeyed overseas may find the answers to things which they did not understand while on ship by reading this book. B. B. A.

MOSCOW DATELINE. By Henry C. Cassidy. Boston: Houghton Mifflin Company. 376 pp. $3.

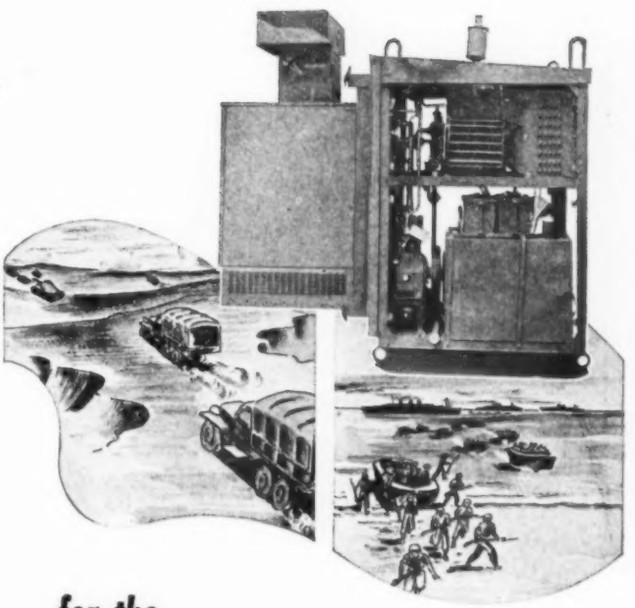
AS THE head of the Associated Press bureau in Russia, after reporting in Spain and France, the author catches the calmness with which Russia went to war with Hitler's legions. The reasons are given why Russia did not collapse as predicted. The protective methods used to safeguard Moscow, the numbers and disposition of the Russian Army, the personal letters to Stalin, and, more surprising, the personal answers which Stalin returned to the questions asked, as well as the frank reporting of Churchill's and Willkie's visits are just a few of the first-hand items in this book. The author's style is gripping, and the humor with which the book is replete is delightful.

Cassidy hesitates to be a prophet, but he concludes that "on the basis of the present record, I should say victorious postwar Soviet Russia would be socialistic, but not internationally revolutionary; atheistic, but not violently antireligious; autocratic, but not antidemocratic." T. K. V.

MILITARY JUSTICE FOR THE FIELD SOLDIER. By Lieut. Col. F. B. Wiener. Washington: *The Infantry Journal*. 122 pp.

COLONEL WIENER, of the Judge Advocate General's Department, Army of the United States, has conducted several

MAKING IT "TOUGH"



for the

ARMY, NAVY, MARINES

Safeguarding food for our fighting men everywhere, with "tough" two-temperature refrigerating units—that's one of Universal Cooler's biggest wartime assignments! An assignment of which Universal Cooler is mighty proud!

Over 20 years of research engineering and production accomplishments prior to World War II . . . more than meeting the exacting demands of the refrigeration industry . . . provides Universal Cooler with facilities and "know how" to produce wartime refrigerating units that operate efficiently in stifling desert heats or sub-zero Arctic colds. From rugged mobile units to permanent units for cold storage warehouses for the Army, Navy and Marines, these units must be "tough" to assure the dependable automatic refrigeration that means substantial, well-rounded meals our fighting men need and deserve. In addition . . .

Lubricating pumps for bombers, traversing mechanisms for aiming tank turret guns, water chests and pumps for cooling anti-aircraft guns are included in the "orders of the day" at Universal Cooler . . . all to help achieve the unconditional surrender of the Axis!

UNIVERSAL COOLER

MARION, OHIO

BRANTFORD, ONTARIO

UNIVERSAL COOLER

WE SELL TO MANUFACTURERS ONLY

UNIVERSAL COOLER CORPORATION

Automatic Refrigeration since 1922

For all types of neutral and cyanide hardening . . . for carburizing, brazing, tempering . . . for age-hardening, selective heating . . . and for hardening high speed steel tools . . . more than a thousand Ajax-Hultgren salt bath furnaces are used today, because:

1. Molten baths "control the atmosphere" by the simple process of eliminating it entirely. Hence scaling, oxidization, or decarburization cannot occur. No other heating medium possesses this valuable characteristic.

2. A salt bath is the fastest heating medium, and Ajax furnaces yield more completed heating cycles per day than radiation or forced convection systems.

3. Heating is uniform, hence distortion cannot occur. This is true because of the operating principle itself, and no other means gives automatic temperature control within such narrow limits (5 deg. F. or less).

4. Selective heating may be done at will in Ajax units.

If you have not yet investigated Ajax-Hultgren installations* send for Catalog 107-A.

AJAX ELECTRIC CO., INC., 911 Frankford Ave., Philadelphia, Pa.

*THERE'S AN AJAX INSTALLATION NEAR YOU

THE AJAX HULTGREN ELECTRIC SALT BATH FURNACE

ASSOCIATE COMPANIES: AJAX METAL COMPANY, Non-Ferrous Ingot Metal for Foundry Use. AJAX ELECTRIC FURNACE CORPORATION, Ajax-Wyatt Induction Furnaces for Melting. AJAX ELECTROTHERMIC CORPORATION, Ajax-Northrup Induction Furnaces for Melting, Heating. AJAX ENGINEERING CORPORATION, Ajax-Tama-Wyatt Aluminum Melting Furnaces

Book Reviews

courses in military law during recent years. Not long ago these lectures were reduced to writing and presented as a series of articles in *The Infantry Journal*. They were so well received that the author expanded the articles and compiled them in book form. When used in conjunction with the Manual for Courts-Martial this volume gives the officer in the field all the material necessary for administering justice in the Army.

In writing the book the author acted on the contention that most texts on military law are written in the language of the lawyer, which is far too comprehensive for the majority of officers to understand without benefit of legal training. Another contention of Colonel Wiener's is that the Manual for Courts-Martial tells what to do in detail but fails to state what must not be done. "Military Justice for the Field Soldier" is written in everyday language and is very interesting to read. Steps to be avoided are listed in detail. There are chapters devoted to the duties of each member of a general court, together with chapters on the preparation and investigation of charges, preparation of the record, and remarks concerning evidence and company punishment. Sample forms for the investigating officer's report are included in the appendix, as well as amendments to the 1920 Articles of War, changes to the 1928 Manual for Courts-Martial, and valuable statements concerning explanations that should be made to the accused.

All officers may derive valuable help from this book. It will be particularly useful to the new officer without previous experience in military law, as the volume tells him exactly what to do, step by step, and in language that may be understood readily.

B. B. A.

THE WRATH OF THE EAGLES. By Frederick Heydenau. Translated by Barrows Mussey. New York: E. P. Dutton & Company. 318 pp. $2.50.

THIS is the drama of the resistance of the Chetniks to German and Italian invasion as depicted by Draja Mikhailovitch and his guerrilla bands—soldiers without rank or pay, an army without guns, tanks, or planes—going about the serious business of stubbornly trying to gain and hold Yugoslav freedom for their people. It is a novel with a Robin Hood type of hero, with adventure told plausibly and humorously. It is a glamorous tale of the life and struggle of a nation of men, women, and children, with a single purpose, suppressed and attacked, but who have time and justice on their side. There is sufficient fact in this great novel to satisfy the discriminating reader. T. K. V.

Books Received

SPEECH FOR THE MILITARY. By Cole S. Brembeck and Albert A. Rights. Harrisburg: Stackpole Sons (The Telegraph Press). 210 pp. $1.20.

SINCE YOU WENT AWAY. By Margaret Buell Wilder. New York: Whittlesey House. 234 pp. $2.

ABRAHAM LINCOLN AND THE FIFTH COLUMN. By George Fort Milton. Washington: *The Infantry Journal*. 247 pp. 25¢.

TEST YOURSELF FOR A WAR JOB. By S. Vincent Wilking and Dorothy J. Cushman. Boston: Houghton Mifflin Company. 137 pp. $1.50.

CASH ALLOWANCES FOR THE FAMILIES AND DEPENDENTS OF SOLDIERS, SAILORS, AND MARINES. By Otto E. Pfeiffenberger, LL.D. New York: The William Frederick Press. 60 pp. 50¢.

PLATING AND FINISHING GUIDEBOOK. Edited by Nathaniel Hall and G. B. Hogaboom, Jr. New York: The Metal Industry Publishing Company. 121 pp. $1.

SCOUTING AND PATROLLING. Washington: *The Infantry Journal*. 124 pp. 25¢.

AIRPLANE POWER. Detroit: General Motors Corporation. 80 pp.

SONGS OF MANY WARS. By Kurt Adler. New York: Howell, Soskin, Publishers, Inc. 221 pp. $3.